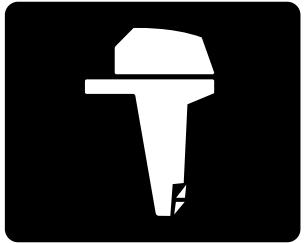




**YAMAHA**



**F200C  
LF200C  
F225C  
LF225C**

**SERVICE MANUAL**



**LIT-18616-02-76**

**69J-28197-1F-11**

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## NOTICE

This manual has been prepared by Yamaha primarily for use by Yamaha dealers and their trained mechanics when performing maintenance procedures and repairs to Yamaha equipment. It has been written to suit the needs of persons who have a basic understanding of the mechanical and electrical concepts and procedures inherent in the work, for without such knowledge attempted repairs or service to the equipment could render it unsafe or unfit for use.

Because Yamaha has a policy of continuously improving its products, models may differ in detail from the descriptions and illustrations given in this publication. Use only the latest edition of this manual. Authorized Yamaha dealers are notified periodically of modifications and significant changes in specifications and procedures, and these are incorporated in successive editions of this manual.

### Important information

Particularly important information is distinguished in this manual by the following notations:

 The Safety Alert Symbol means ATTENTION! BECOME ALERT! YOUR SAFETY IS INVOLVED!

 **WARNING**

---

**Failure to follow WARNING instructions could result in severe injury or death to the machine operator, a bystander, or a person inspecting or repairing the outboard motor.**

---

**CAUTION:**

---

**A CAUTION indicates special precautions that must be taken to avoid damage to the outboard motor.**

---

**NOTE:**

---

A NOTE provides key information to make procedures easier or clearer.

---

**F200C, LF200C, F225C, LF225C  
SERVICE MANUAL**

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**1st Edition, September 2003**

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**LIT-18616-02-76**

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# Contents

<b>General information</b>	 GEN INFO	<b>1</b>
<b>Specifications</b>	 SPEC	<b>2</b>
<b>Periodic checks and adjustments</b>	 CHK ADJ	<b>3</b>
<b>Fuel system</b>	 FUEL	<b>4</b>
<b>Power unit</b>	 POWR	<b>5</b>
<b>Lower unit</b>	 LOWR	<b>6</b>
<b>Bracket unit</b>	 BRKT	<b>7</b>
<b>Electrical systems</b>	 ELEC	<b>8</b>
<b>Troubleshooting</b>	 TRBL SHTG	<b>9</b>
<b>Index</b>		



## General information

<b>How to use this manual .....</b>	<b>1-1</b>
Manual format.....	1-1
Symbols .....	1-2
<b>Safety while working.....</b>	<b>1-3</b>
Fire prevention.....	1-3
Ventilation.....	1-3
Self-protection .....	1-3
Parts, lubricants, and sealants .....	1-3
Good working practices .....	1-4
Disassembly and assembly .....	1-4
<b>Identification.....</b>	<b>1-4</b>
Applicable models .....	1-4
Serial number .....	1-4
<b>Features and benefits .....</b>	<b>1-6</b>
Newly developed V6 4-stroke engine .....	1-6
Valve train system .....	1-9
Intake system .....	1-11
Exhaust system .....	1-11
Fuel system .....	1-13
PTT (Power trim and tilt) unit.....	1-17
<b>Technical tips .....</b>	<b>1-18</b>
Fuel injection control.....	1-18
Fail-safe function table .....	1-20
PTT (Power trim and tilt) unit.....	1-21
Cooling system .....	1-26
Lubrication system.....	1-26
<b>Propeller selection .....</b>	<b>1-27</b>
Propeller size .....	1-27
Selection .....	1-27

---

<b>Predelivery checks .....</b>	<b>1-28</b>
Checking the fuel system .....	1-28
Checking the gear oil.....	1-28
Checking the engine oil .....	1-28
Checking the battery.....	1-28
Checking the outboard motor mounting height.....	1-29
Checking the remote control cables .....	1-29
Checking the steering wheel .....	1-30
Checking the gearshift and throttle operation.....	1-30
Checking the tilt system.....	1-30
Checking the engine start switch and engine stop lanyard switch .....	1-30
Checking the cooling water pilot hole .....	1-31
Test run .....	1-31
Break-in .....	1-31
After test run .....	1-31



## How to use this manual

### Manual format

The format of this manual has been designed to make service procedures clear and easy to understand. Use the information below as a guide for effective and quality service.

- ① Parts are shown and detailed in an exploded diagram and are listed in the components list.
- ② Tightening torque specifications are provided in the exploded diagrams and after a numbered step with tightening instructions.
- ③ Symbols are used to indicate important aspects of a procedure, such as the grade of lubricant and lubrication point.
- ④ The components list consists of parts and part quantities, as well as bolt, screw, O-ring, and hose dimensions.
- ⑤ Service points regarding removal, checking, and installation are shown in individual illustrations to explain the relevant procedure.

### NOTE:

For troubleshooting procedures, see Chapter 9, "Troubleshooting."

**POWER** Power unit

**Cylinder head**

Diagram reference: 5-25

Cylinder head			
No.	Part name	Q'ty	Remarks
1	Cylinder Head	1	
2	Oil pump	1	
3	Cylinder head cover	1	
4	Bolt	7	M6 × 20 mm
5	Cylinder head cover gasket	1	Not reusable
6	Bolt	10	M9 × 95 mm
7	Spark plug	4	
8	Bolt	5	M6 × 25 mm
9	Dowel pin	2	
10	Cylinder head gasket	1	
11	Grommet	4	
12	Anode	4	
13	Cover	4	Not reusable
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			

Diagram reference: 62Y5A11

**POWER** Power unit

**Removing the timing belt and sprockets**

1. Set the cylinder #1 piston position to TDC of the compression stroke by aligning the "1" mark ④ on the driven sprocket with the "▲" mark ⑤ on the cylinder head.
2. Remove the breather hose and loosen the drive sprocket nut ⑥.
3. Remove the tensioner ④ and timing belt ⑤ from the driven sprocket side.
4. Loosen the driven sprocket bolt ⑦ and remove the driven sprocket ⑧.

**CAUTION:**  
Do not turn the drive sprocket counter-clockwise, otherwise the valve system may be damaged.

Diagram reference: S62YS120

**NOTE:**  
Do not turn the camshaft when loosening the driven sprocket bolt.

**NOTE:**  
Crankshaft holder 18 ⑨:  
90890-06562

**Flywheel holder:** 90890-06522

5. Remove the nut ⑩, retaining plates ⑪, and Woodruff key ⑫.

Diagram reference: S62YS150J

# How to use this manual

1

## Symbols

The symbols below are designed to indicate the content of a chapter.

General information



Fuel system



Bracket unit



Specifications



Power unit



Electrical systems



Periodic checks and adjustments



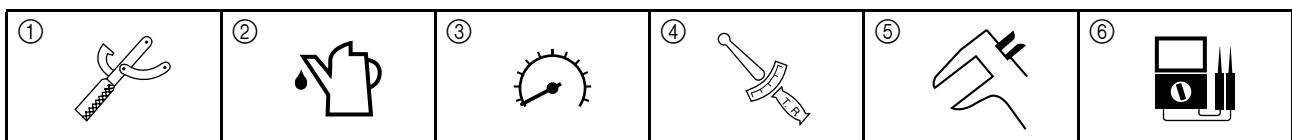
Lower unit



Troubleshooting



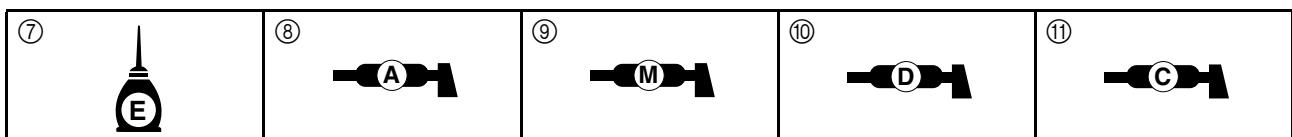
Symbols ① to ⑥ indicate specific data.



- ① Special tool
- ② Specified oil or fluid
- ③ Specified engine speed
- ④ Specified tightening torque

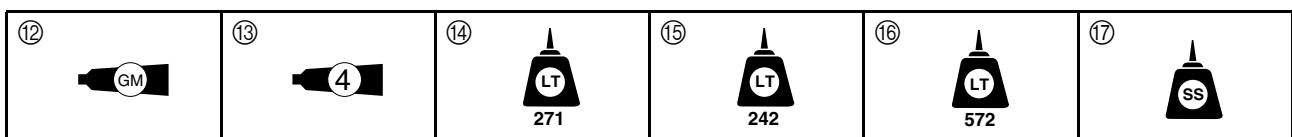
- ⑤ Specified measurement
- ⑥ Specified electrical value  
(resistance, voltage, electric current)

Symbols ⑦ to ⑪ in an exploded diagram indicate the grade of lubricant and the lubrication point.



- ⑦ Apply Yamaha 4-stroke motor oil
- ⑧ Apply water resistant grease (Yamaha grease A)
- ⑨ Apply molybdenum disulfide grease
- ⑩ Apply corrosion resistant grease (Yamaha grease D)
- ⑪ Apply low temperature resistant grease (Yamaha grease C)

Symbols ⑫ to ⑯ in an exploded diagram indicate the type of sealant or locking agent and the application point.



- ⑫ Apply Gasket Maker®
- ⑬ Apply Yamabond No. 4
- ⑭ Apply LOCTITE® No. 271 (Red)

- ⑮ Apply LOCTITE® No. 242 (Blue)
- ⑯ Apply LOCTITE® No. 572
- ⑰ Apply silicon sealant



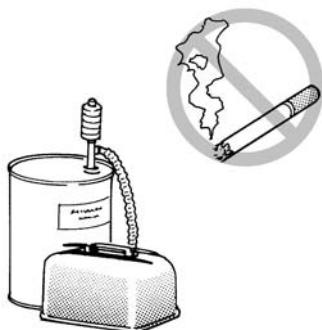
## Safety while working

To prevent an accident or injury and to ensure quality service, follow the safety procedures provided below.

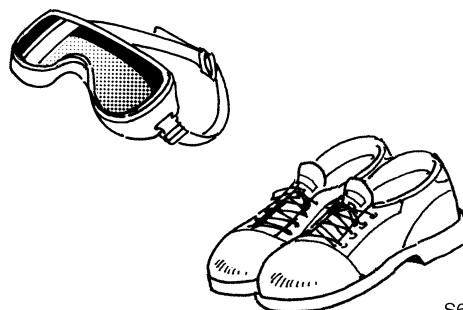
### Fire prevention

Gasoline is highly flammable.

Keep gasoline and all flammable products away from heat, sparks, and open flames.



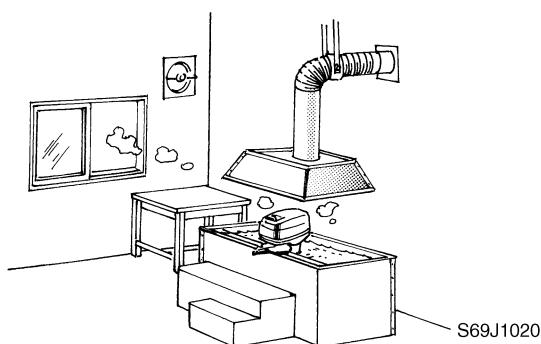
S69J1010



S69J1030

### Ventilation

Gasoline vapor and exhaust gas are heavier than air and extremely poisonous. If inhaled in large quantities they may cause loss of consciousness and death within a short time. When test running an engine indoors (e.g., in a water tank) be sure to do so where adequate ventilation can be maintained.



S69J1020

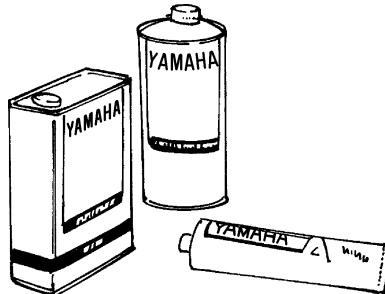
### Self-protection

Protect your eyes by wearing safety glasses or safety goggles during all operations involving drilling and grinding, or when using an air compressor.

Protect your hands and feet by wearing protective gloves and safety shoes when necessary.

### Parts, lubricants, and sealants

Use only genuine Yamaha parts, lubricants, and sealants or those recommended by Yamaha, when servicing or repairing the outboard motor.



S69J1040

Under normal conditions, the lubricants mentioned in this manual should not harm or be hazardous to your skin. However, you should follow these precautions to minimize any risk when working with lubricants.

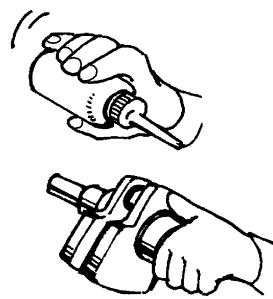
1. Maintain good standards of personal and industrial hygiene.
2. Change and wash clothing as soon as possible if soiled with lubricants.
3. Avoid contact with skin. Do not, for example, place a soiled rag in your pocket.
4. Wash hands and any other part of the body thoroughly with soap and hot water after contact with a lubricant or lubricant soiled clothing has been made.
5. To protect your skin, apply a protective cream to your hands before working on the outboard motor.

- Keep a supply of clean, lint-free cloths for wiping up spills, etc.

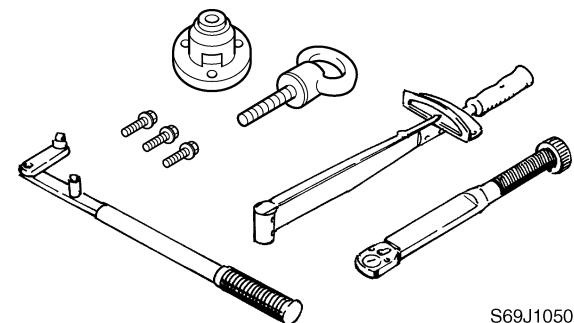
### Good working practices

#### Special tools

Use the recommended special tools to protect parts from damage. Use the right tool in the right manner—do not improvise.



S69J1070



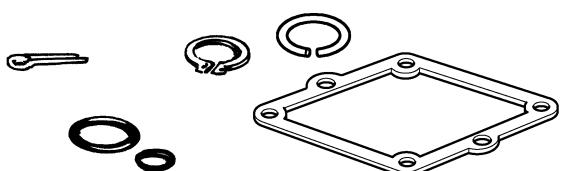
S69J1050

#### Tightening torques

Follow the tightening torque specifications provided throughout the manual. When tightening nuts, bolts, and screws, tighten the large sizes first, and tighten fasteners starting in the center and moving outward.

#### Non-reusable parts

Always use new gaskets, seals, O-rings, cotter pins, circlips, etc., when installing or assembling parts.



S69J1060

#### Disassembly and assembly

- Use compressed air to remove dust and dirt during disassembly.
- Apply engine oil to the contact surfaces of moving parts before assembly.

- Install bearings with the manufacture identification mark in the direction indicated in the installation procedure. In addition, be sure to lubricate the bearings liberally.
- Apply a thin coat of water-resistant grease to the lip and periphery of an oil seal before installation.
- Check that moving parts operate normally after assembly.

### Identification

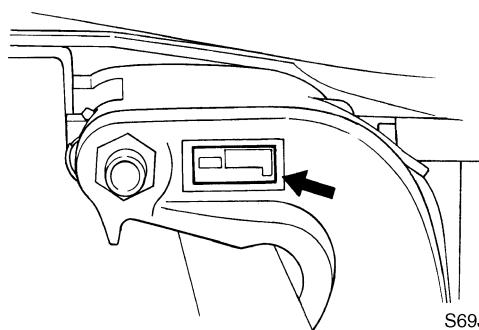
#### Applicable models

This manual covers the following models.

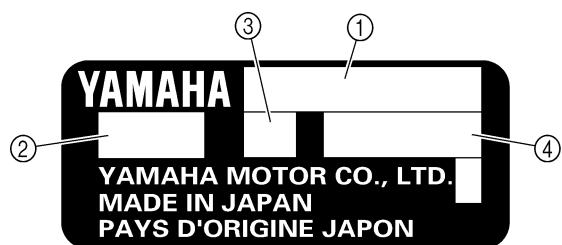
Applicable models
F200TR, LF200TR, F225TR, LF225TR

#### Serial number

The outboard motor serial number is stamped on a label attached to the port clamp bracket.



S69J1080



S69J1090N

- ① Model name
- ② Approved model code
- ③ Transom height
- ④ Serial number

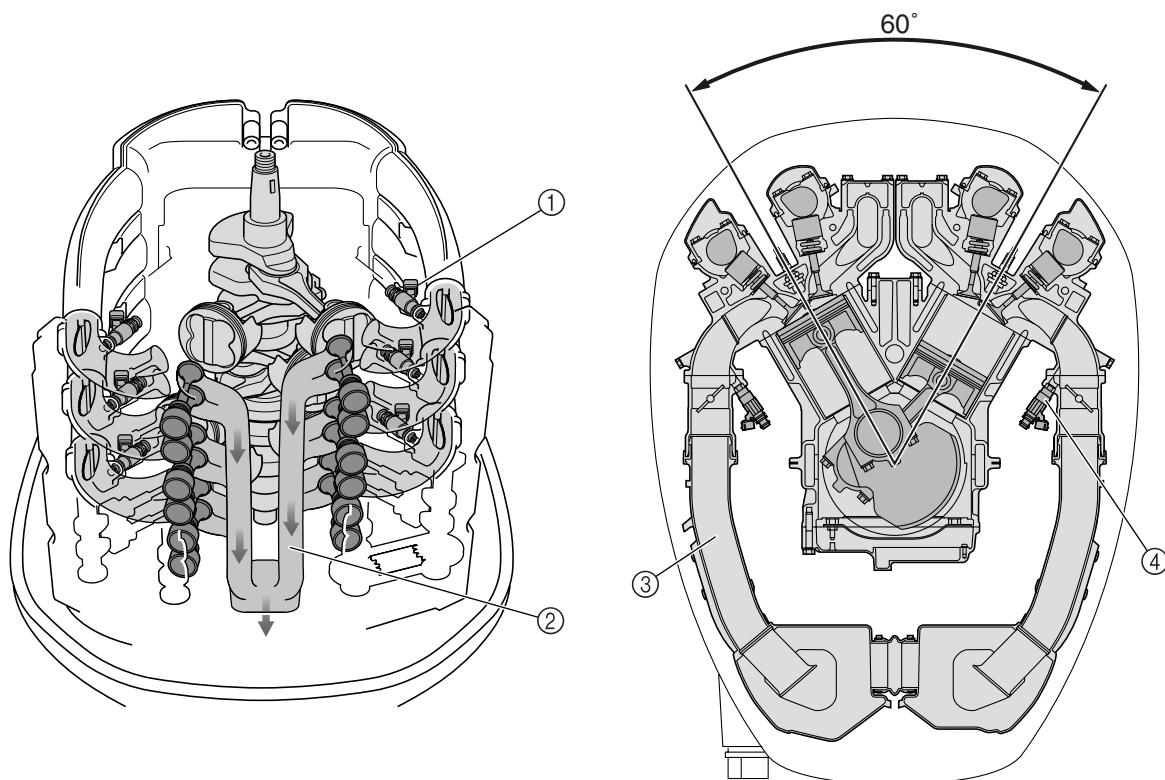
Model name	Approved model code	Starting serial No.
F200TR	60L	1001799-
LF200TR	60M	1000373-
F225TR	69J	1007259-
LF225TR	69K	1002513-

### Features and benefits

#### Newly developed V6 4-stroke engine

The F225 is a newly developed 60-degree V6 4-stroke engine with a very compact and lightweight design. Its size and weight are almost the same as the V6 2-stroke engines that are in current use. This F225 offers numerous advantages of a 4-stroke engine. Compared to conventional 2-stroke models, it emits much cleaner exhaust gases, offers a better fuel economy, and realizes lower noise levels at idle and full throttle.

Through the newly developed “In-bank exhaust system,” which discharges exhaust gases from the center of both banks, the engine block and the surrounding equipment have been made compact. In addition, the six independent intake passages help to achieve a high level of driveability and power output.



S69J1250

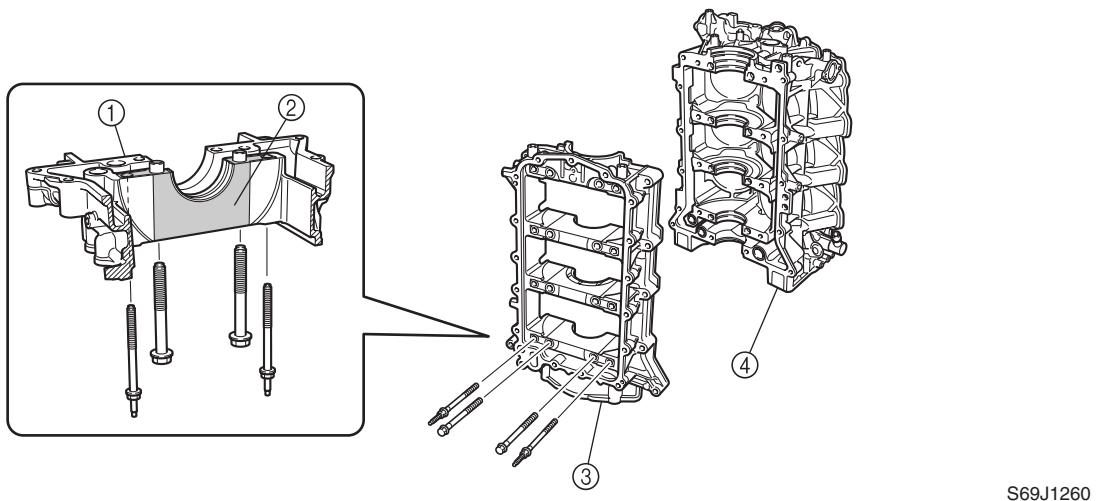
- ① Electronic Fuel Injection
- ② In-bank exhaust system
- ③ Pulse tuned long intake tracks
- ④ Individual inside track fuel injectors



### Crankcase

The crankcase is made of cast aluminum, however steel has been cast into the areas for the crankshaft bearings. By distinguishing the area that requires strength from the area that allows the use of a lighter material, both weight reduction and a stronger construction have been achieved.

The caps for the crankshaft bearings are secured with four bolts to ensure a high level of assembled rigidity.

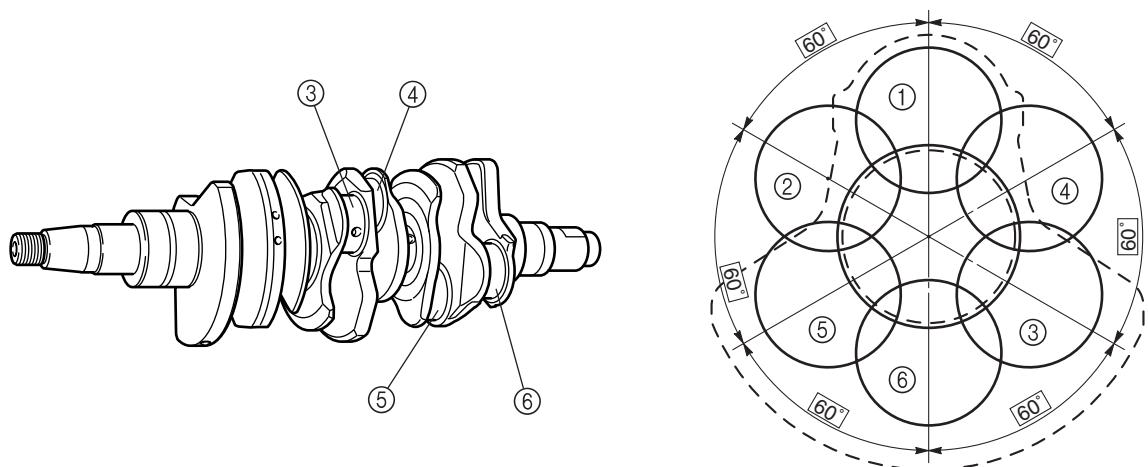


- ① Casted aluminum
- ② Steel

- ③ Crankcase
- ④ Cylinder block

### Crankshaft

The crankshaft has been forged to realize a high-strength and high-rigidity construction. In the 60-degree V6 cylinder configuration, the crankshaft pins are staggered 60 degrees from each other.

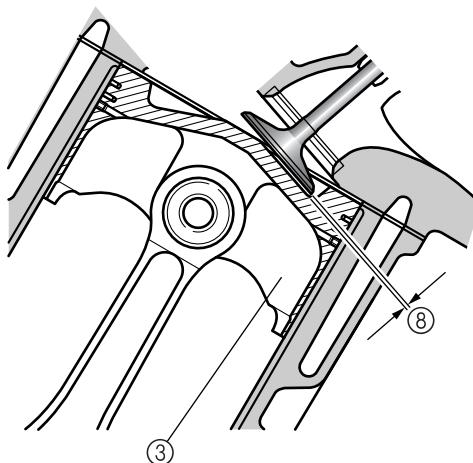
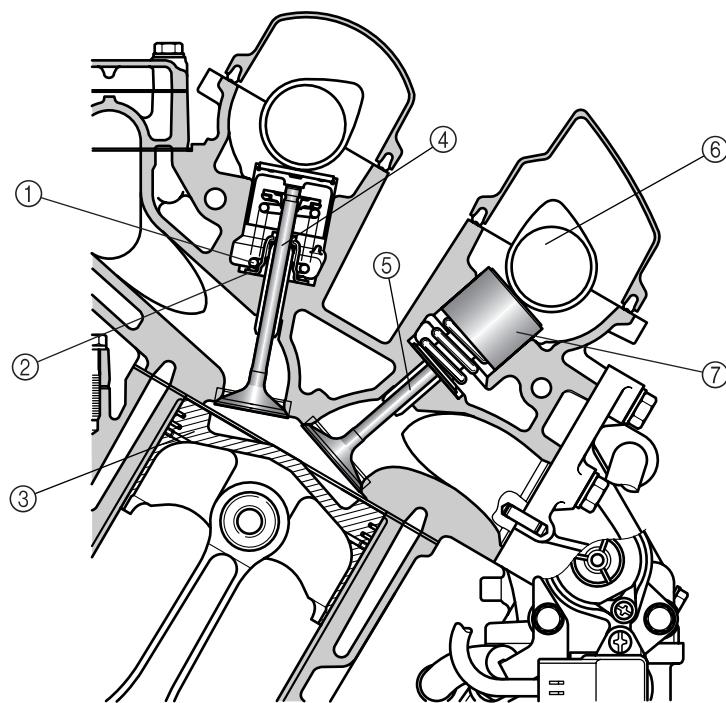


- ① Crankpin #1
- ② Crankpin #2
- ③ Crankpin #3

- ④ Crankpin #4
- ⑤ Crankpin #5
- ⑥ Crankpin #6

### Piston

The piston has been carved out of a forged stock. To prevent the valves from coming in contact with the piston, the piston is provided with a valve recess. If the engine goes out of timing and a valve opens when the piston is at top-dead-center, this recess prevents the valve from coming in contact with the piston, thus preventing engine damage.



S69J1280

- ① Valve spring
- ② Valve seal
- ③ Piston
- ④ Valve stem

- ⑤ Intake valve
- ⑥ Intake camshaft
- ⑦ Valve lifter
- ⑧ Valve recess



## Valve train system

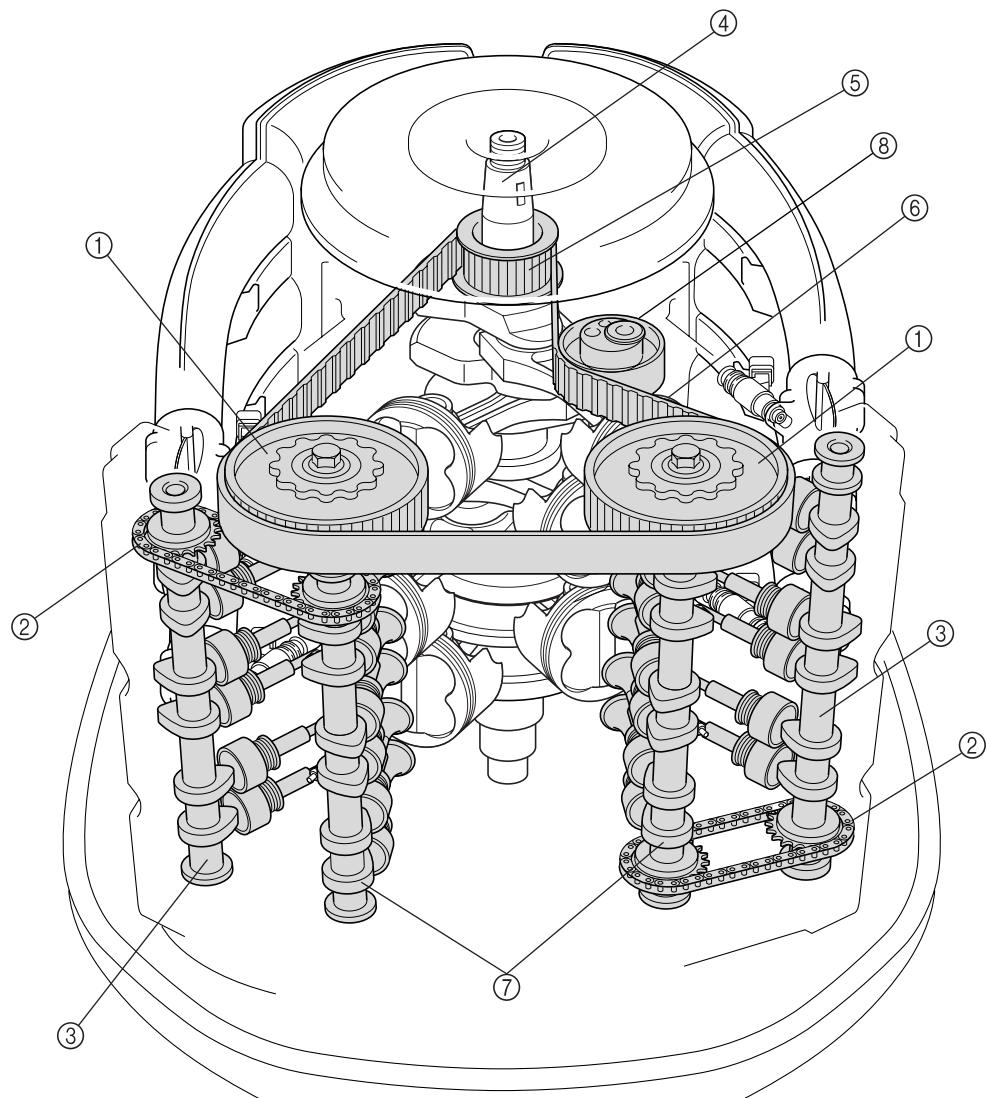
The valve train consists of a total of four camshafts, with two in each bank.

The camshafts are driven with the combination of a belt and chains. The crankshaft turns the belt to drive the exhaust camshafts in both banks. Chains connect the exhaust camshafts to the intake camshafts in the cylinder heads to drive the intake camshafts.

In addition, the timing belt offers quieter operation, and the cam chains help to achieve a compact configuration through the use of individual driven sprockets.

### Timing belt

The timing belt, which is driven by the drive sprocket that is attached to the crankshaft, rotates the driven sprockets that are attached to the exhaust camshafts of both banks. The drive sprocket for the timing belt is secured to the crankshaft by four bolts, and it can be removed easily for servicing. In addition, the material of the driven sprockets has been changed from the previous metal to plastic for weight reduction.



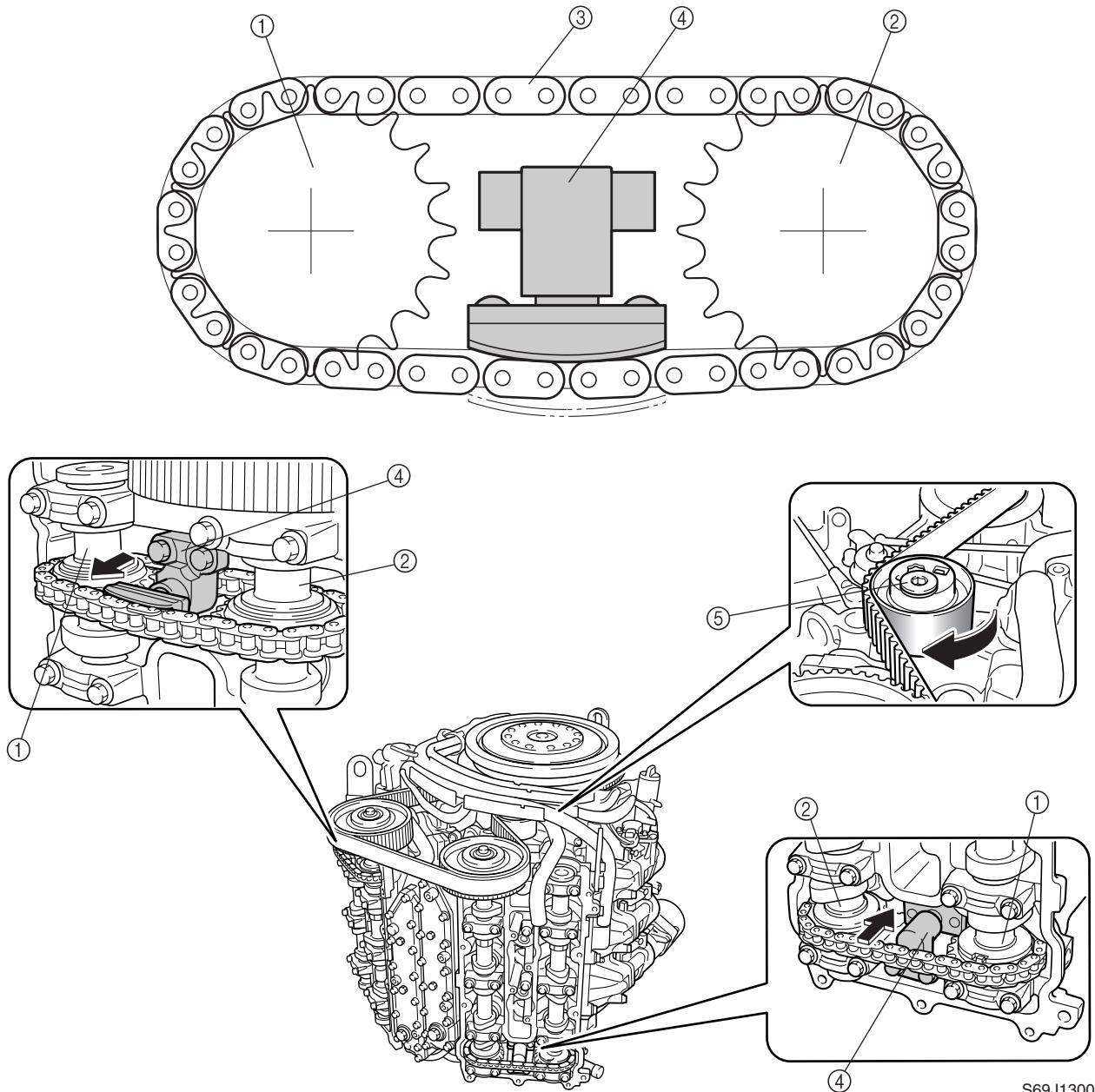
S69J1290

- ① Driven sprocket
- ② Timing chain
- ③ Intake camshaft
- ④ Crankshaft
- ⑤ Drive sprocket

- ⑥ Timing belt
- ⑦ Exhaust camshaft
- ⑧ Hydraulic timing belt tensioner

### Tensioner

A timing chain tensioner is provided at the mid-span of the timing chain, between both camshafts. The timing chain tensioner uses the force of a spring to maintain its tension. After the engine is started, oil is pumped into the tensioner, and the resulting pressure causes the tension to increase. A total of three tensioners are used, one for the timing belt, and one for each timing chain of both banks, to maintain proper tension and to ensure the reliability of the valve train.

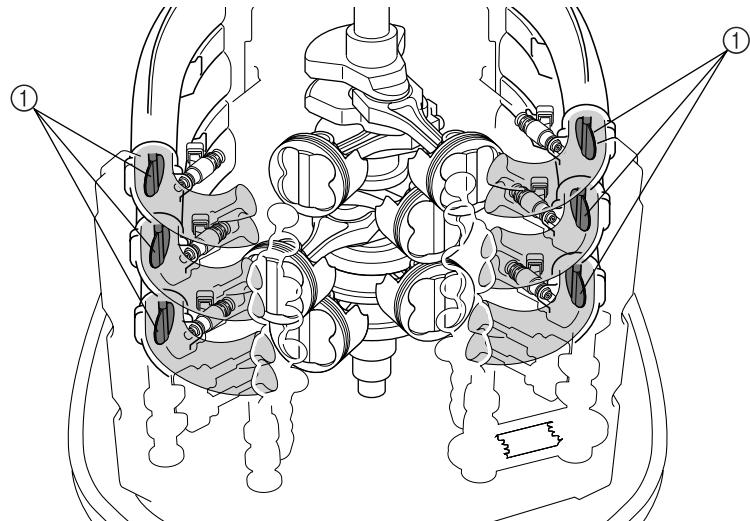


- ① Intake camshaft
- ② Exhaust camshaft
- ③ Timing chain
- ④ Timing chain tensioner
- ⑤ Hydraulic timing belt tensioner

## Intake system

### Throttle valve

A total of six intake throttle valves are provided, one for each cylinder. Together with the intake silencer that offers enhanced intake efficiency and the injectors that are provided at each throttle body, the throttle valves help to improve the intake efficiency of the engine. As a result, this engine produces a higher power output and realizes better driveability.



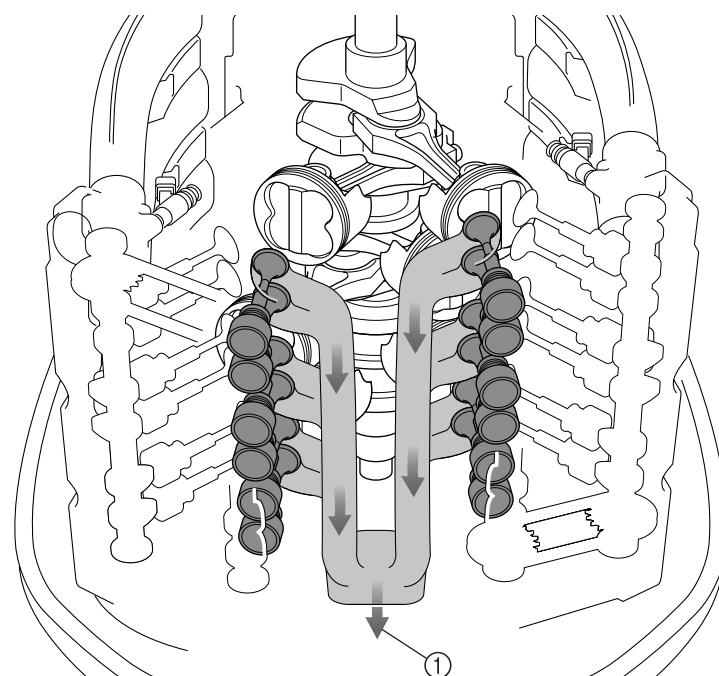
S69J1310

① Throttle valve

## Exhaust system

### In-bank exhaust system

The exhaust passage of the F225 is located in the V bank, a layout that is the opposite of conventional V6 engines. By providing the exhaust passage in the V bank, the engine has been made considerably more compact.



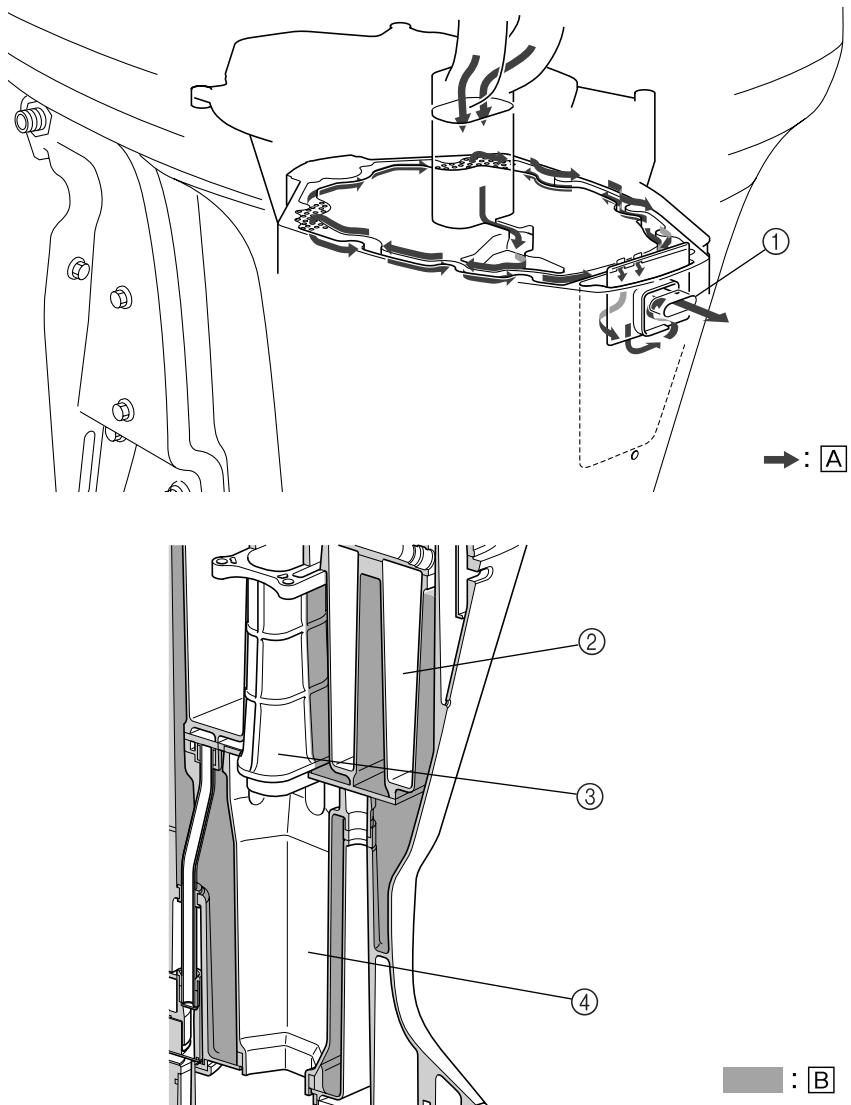
S69J1320

① Exhaust gas

### Exhaust passage during idle

To reduce noise when the engine is idling, the exhaust gas passage of the F225 has adopted a labyrinth construction. During idling, the exhaust gas passes through the passage on the side of the exhaust guide, and enters the upper case through a hole in the upper case gasket. When it fills the upper case, the exhaust gas enters another passage on the side of the exhaust guide through another hole in the upper case gasket. Then, it is discharged through the idle port that is provided in the upper case.

The exhaust manifold and muffler in the upper case are surrounded by the water jackets to reduce exhaust noise. The water jackets also help prevent corrosion by preventing the exterior of the exhaust manifold and muffler from coming in direct contact with the exhaust gas.



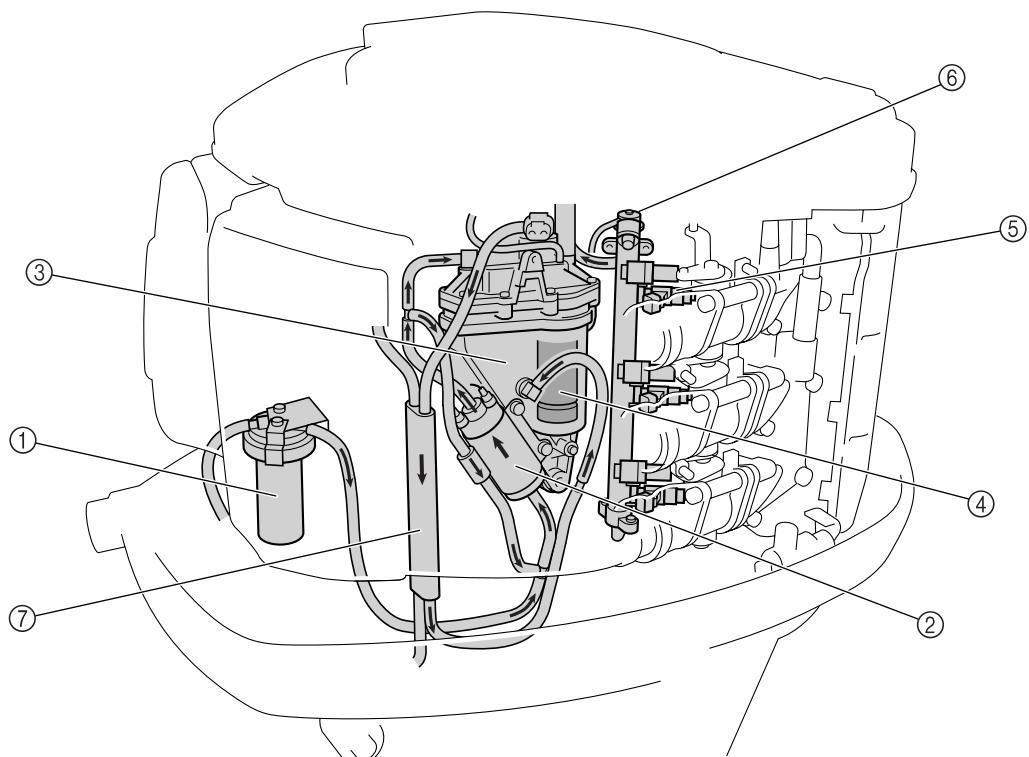
- ① Idle port
- ② Oil pan
- ③ Exhaust manifold
- ④ Muffler
- A Exhaust gas
- B Water



## Fuel system

The fuel flows in the following order: fuel filter, low-pressure fuel pump, vapor separator, high-pressure fuel pump, and injectors. The excess fuel at the injectors passes through the pressure regulator and fuel cooler, and returns to the vapor separator.

When the engine start switch is turned on, the injectors of all cylinders operate before the pump relay is actuated to prevent the injectors from sticking.



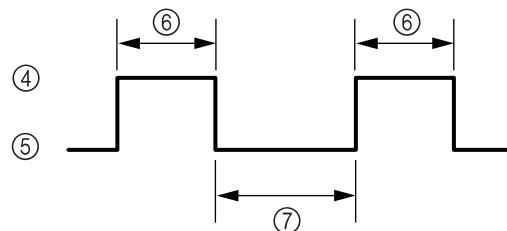
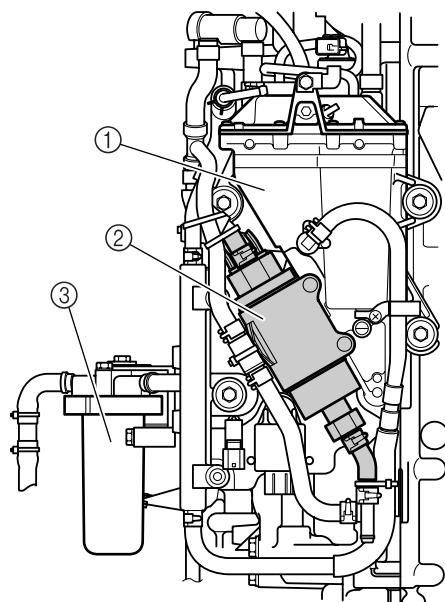
- ① Fuel filter
- ② Low-pressure fuel pump
- ③ Vapor separator
- ④ High-pressure fuel pump

- ⑤ Fuel injector
- ⑥ Pressure regulator
- ⑦ Fuel cooler

### Low-pressure fuel pump

The F225 has adopted a newly developed, low-pressure electrical fuel pump, in place of the low-pressure mechanical fuel pump used in the previous electronic fuel injection system. With the adoption of the electric pump, the routing of the fuel system has been made more compact. To prevent the over-pumping of fuel, this pump operates for 10 seconds, and stops for 20 seconds when the engine is operating at low speeds.

The pump operates constantly if the engine speed is 1,200 r/min or higher, or for several seconds (which vary by ambient temperature) after the engine is started. At other times, it operates for 10 seconds, and stops for 20 seconds to prevent over-pumping.



S69J1350

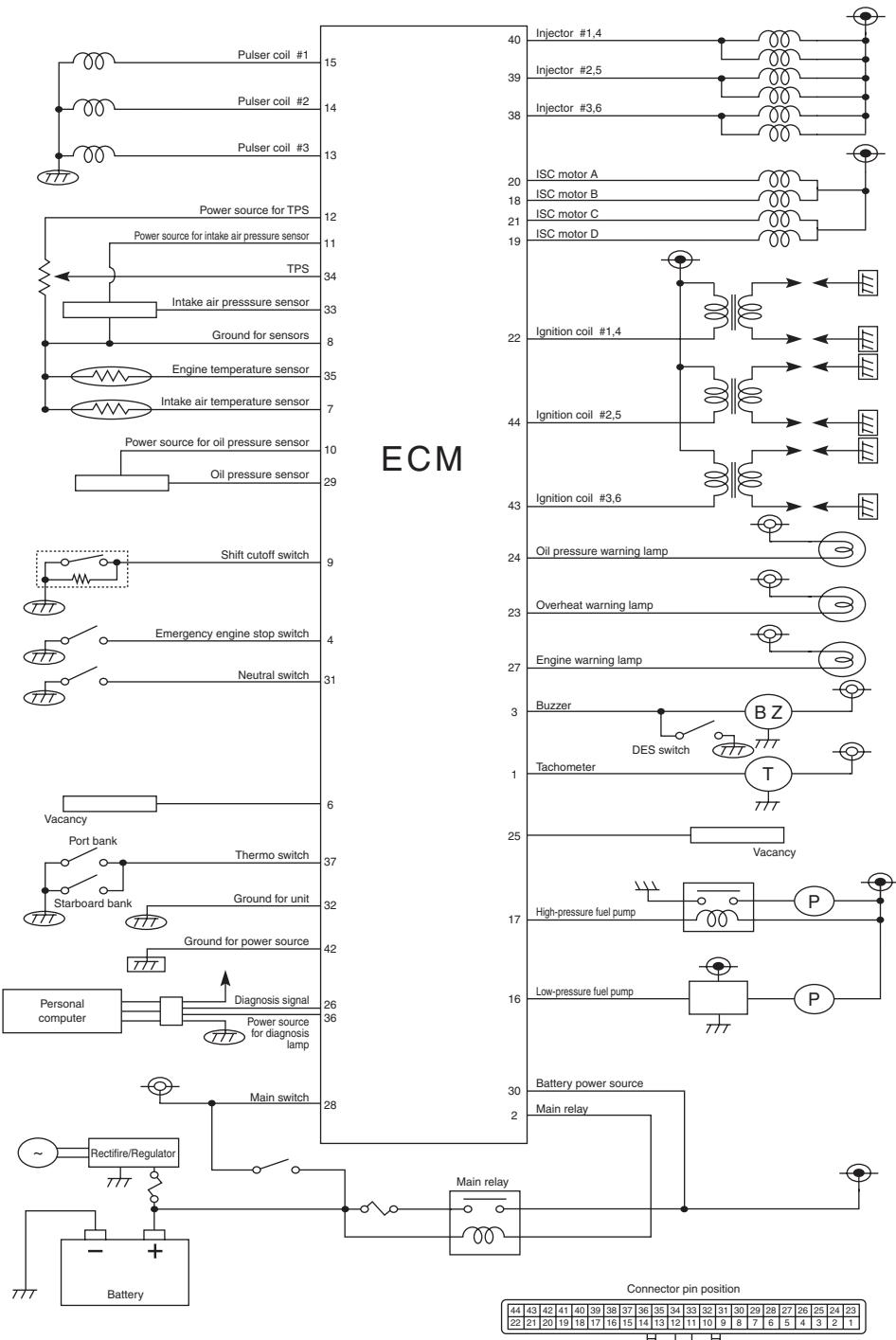
- ① Vapor separator
- ② Low-pressure fuel pump
- ③ Fuel filter
- ④ On

- ⑤ Off
- ⑥ 10 seconds
- ⑦ 20 seconds



### Electronic control system

The ECM controls the ignition timing, the fuel injection timing, the fuel injection volume, and the ISC and it maintains a stoichiometric air-fuel ratio in all operating conditions, including starting and idling. Also, the ECM converts the signals from the input sensors and sends instructions to each part.



S60L1180

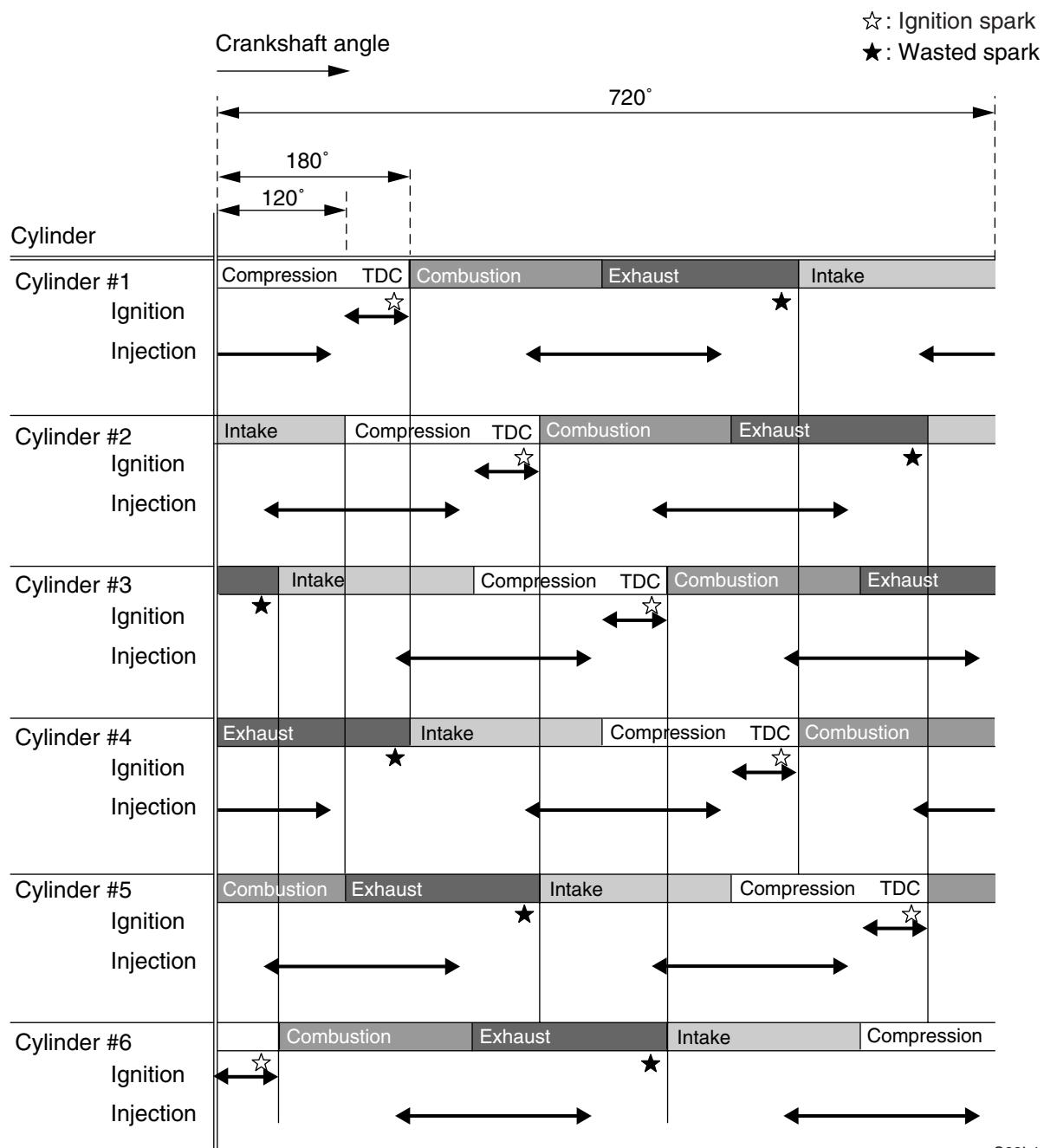
### Ignition and fuel injection timing

This engine adopted the group injection system that the fuel required for one combustion is injected twice per one cycle.

Therefore, the injector driving circuits can be integrated to 3 circuits and a simpler electrical structure is obtained.

Firing order : #1, #2, #3, #4, #5, #6

Injection order : #1 and #4 → #2 and #5 → #3 and #6 (group injection)

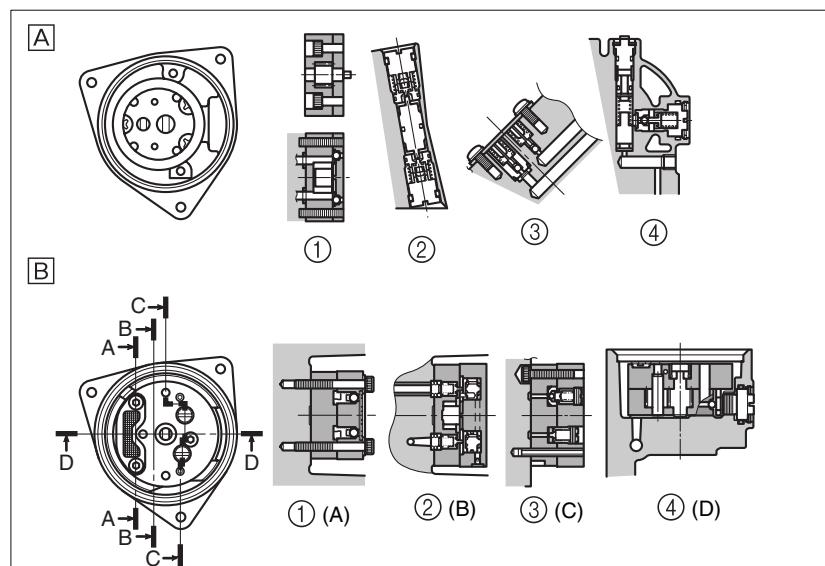
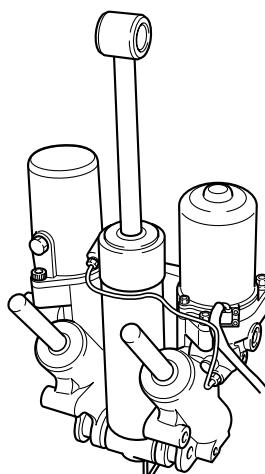


S60L1190



### PTT (Power trim and tilt) unit

The PTT unit has been newly developed for the F225. Based on the field-proven 61A type, its PTT fluid passage and internal valve construction have been changed for this application. Although the valves of the 61A type have been distributed to the various areas of the gear pump housing, the valves of the new PTT unit have been concentrated in the vicinity of the gear pump to improve their serviceability. In addition, the material of the gear pump housing has been changed to enhance its corrosion resistance.



S69J1380

- ① Gear pump
- ② Main valve
- ③ Relief valve

- ④ Manual valve
- A 61A type
- B F225 type

### Technical tips

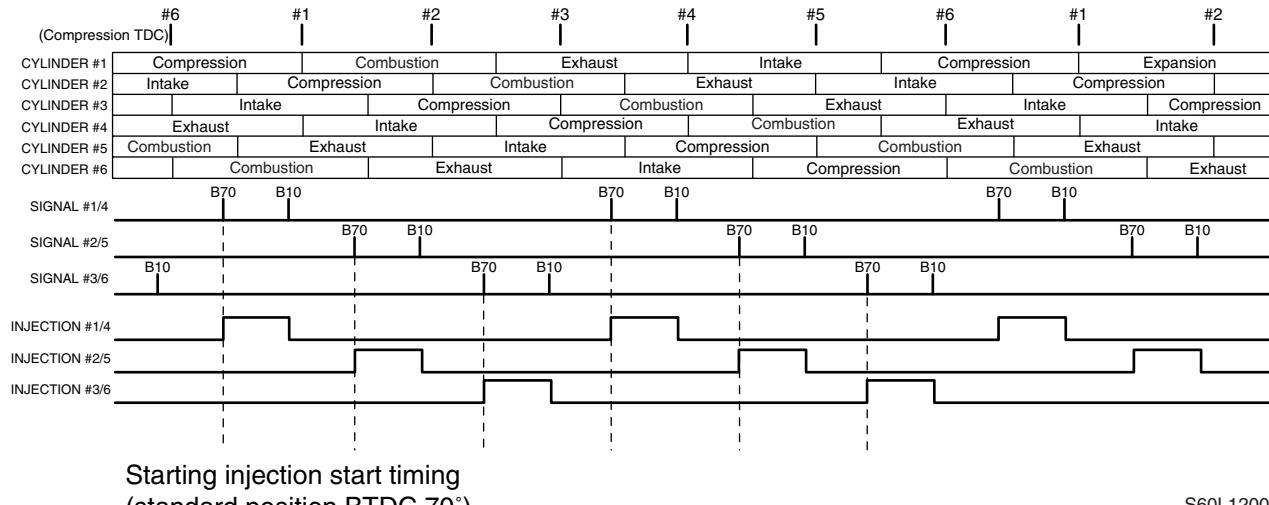
#### Fuel injection control

The F200/F225 injects fuel simultaneously to the following cylinder pairs: #1 and #4, #2 and #5, and #3 and #6. Optimal injection timing is provided in accordance with the operating conditions of the engine.

1

#### Starting fuel injection volume and injection timing

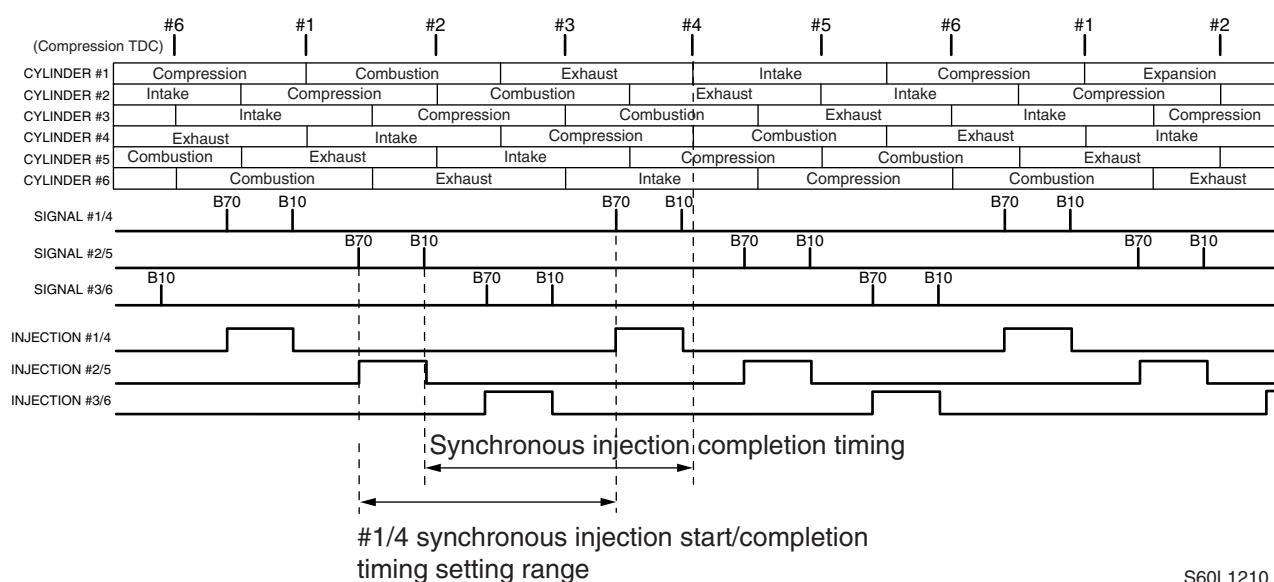
The injectors are actuated in sync with the standard crankshaft position signals (BTDC 70°) for cylinder pairs #1 and #4, #2 and #5, and #3 and #6, respectively.



S60L1200

#### Normal fuel injection volume and injection timing

To control the actuation timing of the injectors, the injection ending timing is established by using the top-dead-center of the intake stroke as the standard, for cylinder pairs #1 and #4, #2 and #5, and #3 and #6, respectively.



S60L1210

**Over-revolution control**

If the engine speed exceeds 4,500 r/min, while the shift is in neutral, ignition is stopped. The various stages of ignition cutoff are shown in the table below.

**Ignition cutoff cylinder in neutral**

Set speed (r/min)	#1	#2	#3	#4	#5	#6
4,500	○	○	△	○	○	△
4,750	○	○	○	○	○	○

△: Indicates a misfire at either cylinder (once, due to simultaneously firing).

○: Indicates a misfire at both cylinders (twice continuous).

If the engine speed exceeds 6,200 r/min, while the shift is in forward or reverse, the ignition is stopped. The various stages of ignition cutoff are shown in the table below.

**Ignition cutoff cylinder in forward or reverse**

Set speed (r/min)	#1	#2	#3	#4	#5	#6
6,200	△			△		
6,250	○			○		
6,300	○	△		○	△	
6,350	○	○		○	○	
6,400	○	○	△	○	○	△
6,450	○	○	○	○	○	○

△: Indicates a misfire at either cylinder (once, due to simultaneously firing).

○: Indicates a misfire at both cylinders (twice continuous).

**Dual-engine control**

When two outboard engines are used, if one of the engines enters any one of the control modes, the other engine will also control its ignition. This control is activated with the same engine speeds as with other control modes.

**Shift cutoff control**

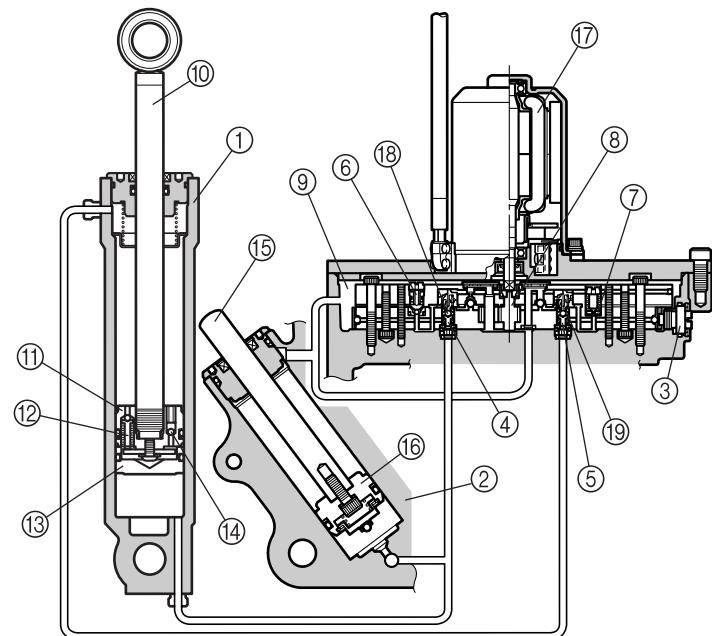
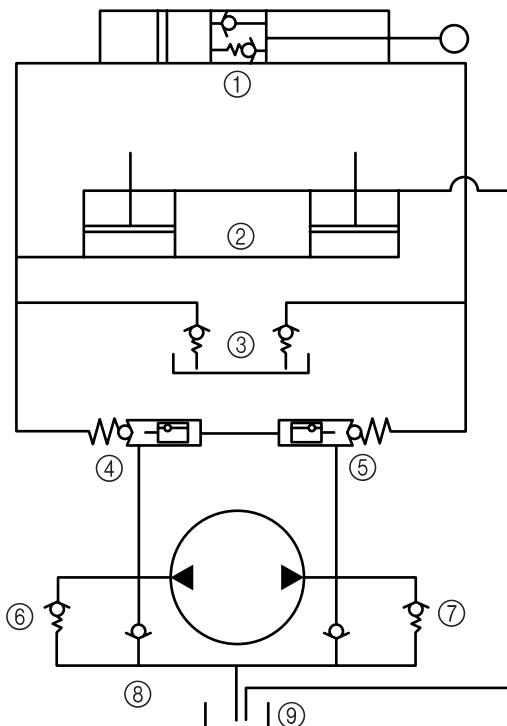
If the shift cut switch is activated with the engine operating under 2,000 r/min, the system causes one or two cylinders to misfire in order to facilitate shifting. The system causes cylinders #1 and #2, or #4 and #5 to misfire when the engine speed is over 850 r/min, and cylinder #1 or #4 to misfire when the engine speed is under 850 r/min.

**Fail-safe function table**

Symptom	FAIL-SAFE FUNCTION				DIAGNOSIS CODE
	Ignition	Injection	ISC	Engine condition	
Incorrect pulser coil signal	Engine starting: Only the cylinders outputting normal signal ignite at BTDC10°, and all cylinders thereafter.	All cylinders inject simultaneously based on the cylinder that is outputting a normal signal.	Only in neutral: 900 r/min	Idle speed increases	13
Incorrect engine temperature sensor signal	Normal control	Engine temperature sensor is fixed to 40 °C to activate normal control.	Only in neutral: 900 r/min	Idle speed increases	15
Incorrect throttle position sensor signal	Ignition timing is fixed to BTDC10°.	Correction is made to the basic injection map.	Opening angle is fixed to 60%.	Idle speed increases	18
Incorrect intake air temperature sensor signal	Normal control	Intake air temperature sensor is fixed to 40 °C in order to activate normal control.	Only in neutral: 900 r/min	Idle speed increases	23
Incorrect neutral switch signal	Normal control	Normal control	Normal control	Normal control	28
Incorrect intake air pressure sensor signal	Normal control	Correction is made to the basic injection map.	Only in neutral: 900 r/min	Idle speed increases	29
Incorrect oil pressure sensor signal	Normal control	Normal control	Only in neutral: 900 r/min	Idle speed increases	39
Incorrect shift cut switch signal	Normal control	Normal control	In neutral: 900 r/min In gear: 850 r/min	Idle speed increases	45
Incorrect thermo-switch signal	Normal control	Normal control	Only in neutral: 900 r/min	Idle speed increases	46

**PTT (Power trim and tilt) unit**

In the newly designed PTT unit, the up-main valve, down-main valve, up-relief valve, and down-relief valve have been concentrated in the gear pump housing in order to improve the serviceability of the engine and ensure reliable operation.



S69J1410

- ① Tilt cylinder
- ② Trim cylinder
- ③ Manual valve
- ④ Up-main valve
- ⑤ Down-main valve
- ⑥ Up-relief valve
- ⑦ Down-relief valve
- ⑧ Gear pump
- ⑨ Reservoir
- ⑩ Tilt ram

- ⑪ Tilt piston
- ⑫ Tilt piston absorber
- ⑬ Free piston
- ⑭ Shock return valve
- ⑮ Trim ram
- ⑯ Trim piston
- ⑰ Power trim and tilt motor
- ⑱ Up-shuttle piston
- ⑲ Down-shuttle piston

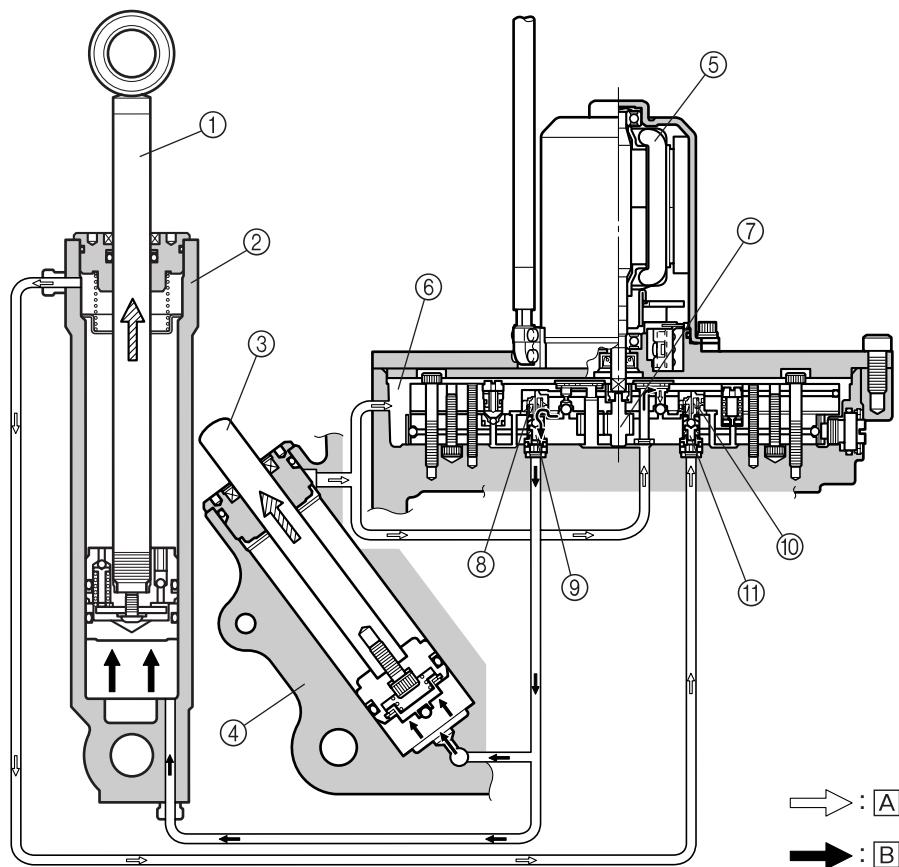
### Trim-up and tilt-up function

When the PTT switch is pressed to "UP," the power trim and tilt motor operates the gear pump and fluid pressure is generated. As a result, the fluid pressure pushes the up-shuttle piston upward, enters the trim cylinder and tilt cylinder lower chambers through the up-main valve, and then pushes the tilt ram and trim ram upward.

In addition, the fluid pushes the down-shuttle piston downward, opens the down-main valve, and returns the PTT fluid from the tilt cylinder upper chamber to the gear pump.

The fluid from the trim cylinder upper chamber then returns to the reservoir.

The tilt ram and the trim ram extend simultaneously, and after the trim ram has extended completely, the tilt ram operates to tilt up.



S69J1420

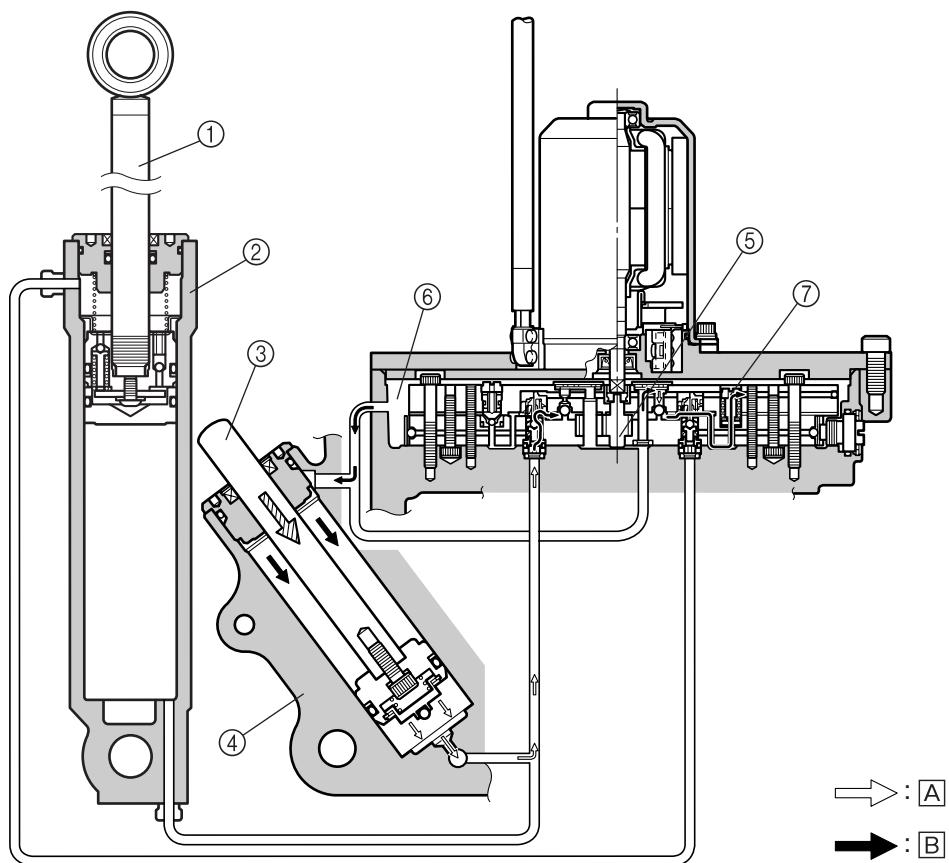
- ① Tilt ram
- ② Tilt cylinder
- ③ Trim ram
- ④ Trim cylinder
- ⑤ Power trim and tilt motor
- ⑥ Reservoir
- ⑦ Gear pump

- ⑧ Up-shuttle piston
- ⑨ Up-main valve
- ⑩ Down-shuttle piston
- ⑪ Down-main valve
- A Return
- B Send

**Trim ram retraction function**

When the outboard motor is tilted up and held in place with the tilt stop lever and the PTT switch is pressed to "DN," the trim ram will be retracted.

Although the gear pump attempts to draw oil from the tilt cylinder and trim cylinder lower chambers, after the PTT switch has been pressed, fluid cannot be drawn from the tilt cylinder lower chamber because the tilt ram is secured in place by the tilt stop lever. Only the PTT fluid from the trim cylinder lower chamber can be drawn, and as the fluid pressure decreases, the trim ram retracts into the trim cylinder. Since the tilt ram is secured in place, the PTT fluid pumped by the gear pump flows into the tilt cylinder upper chamber to increase fluid pressure. As a result, the down-relief valve opens, and the PTT fluid is released into the reservoir.



- ① Tilt ram
- ② Tilt cylinder
- ③ Trim ram
- ④ Trim cylinder
- ⑤ Gear pump

- ⑥ Reservoir
- ⑦ Down-relief valve
- A Return
- B Send

S69J1430

### Trim-down and tilt-down function

When the PTT switch is pressed to “DN,” the power trim and tilt motor operates the gear pump and fluid pressure is generated. As a result, the fluid pressure pushes the down-shuttle piston upward, enters the tilt cylinder upper chamber through the down-main valve, and then pushes the tilt ram downward.

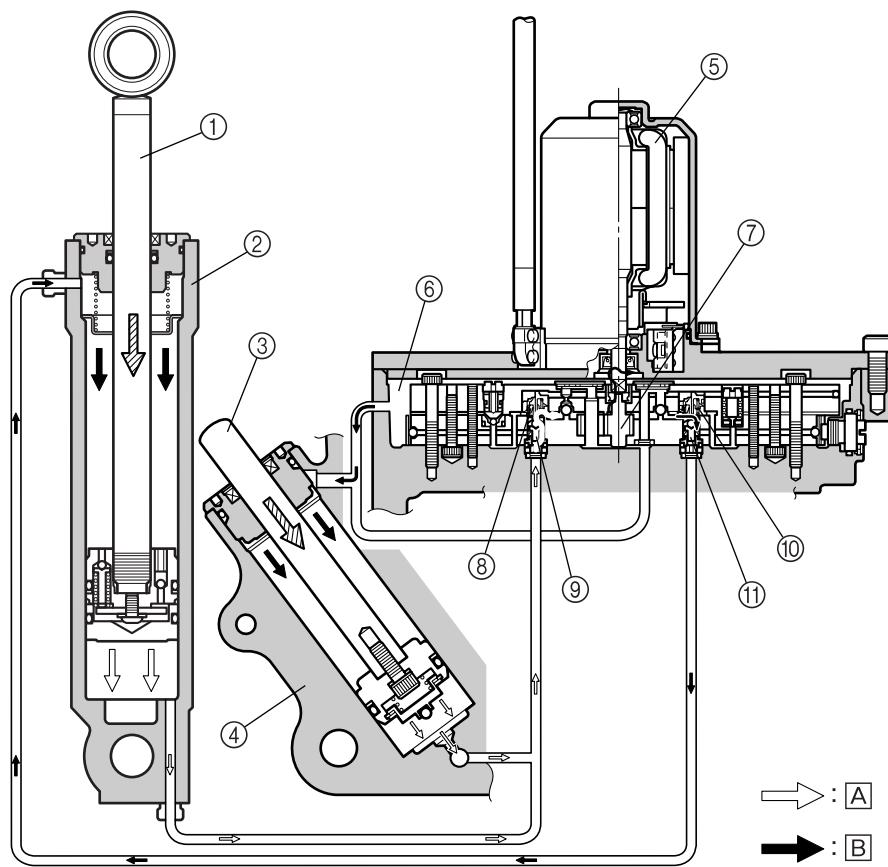
In addition, the fluid pushes the up-shuttle piston downward to open the up-main valve.

The gear pump draws the PTT fluid from the tilt cylinder and trim cylinder lower chambers, and then retracts the tilt ram and the trim ram.

Since the fluid pressure from the gear pump is applied to the tilt cylinder upper chamber, the tilt ram moves downward first.

The hydraulic oil flows into the trim cylinder upper chamber from the reservoir.

When the outboard motor comes in contact with the trim ram, the trim ram moves downward simultaneously with the tilt ram, due to its own weight and the suction of the PTT fluid by the trim cylinder lower chamber.



S69J1440

- ① Tilt ram
- ② Tilt cylinder
- ③ Trim ram
- ④ Trim cylinder
- ⑤ Power trim and tilt motor
- ⑥ Reservoir
- ⑦ Gear pump

- ⑧ Up-shuttle piston
- ⑨ Up-main valve
- ⑩ Down-shuttle piston
- ⑪ Down-main valve
- A Return
- B Send



### Stationary condition

When the PTT switch is not pressed, the gear pump will not pump the fluid, the up-main valve and the down-main valve will remain closed, and the PTT unit in the system remains constant. This will allow the tilt ram and the trim ram to maintain their positions until the PTT fluid flows through the system again.

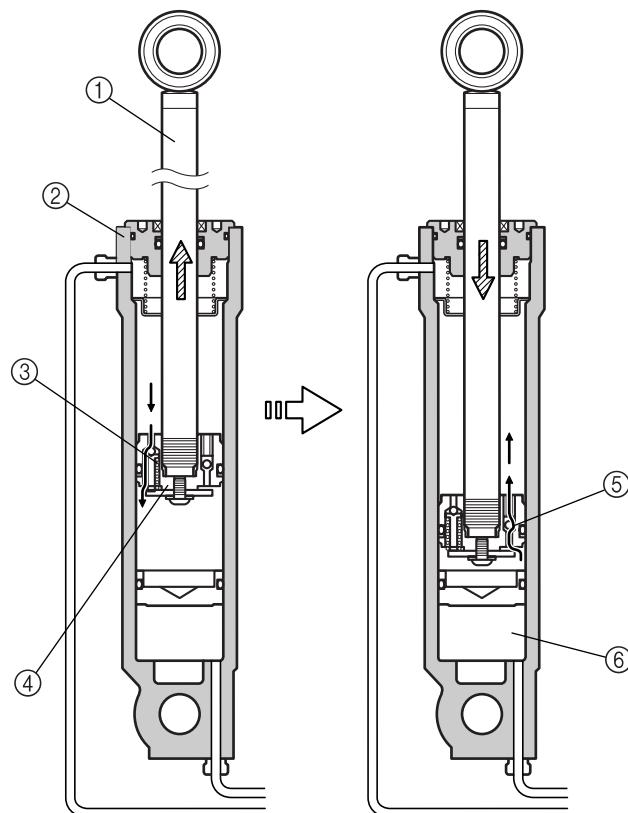
### When the outboard hits something in the water

If the lower casing comes in contact with an obstacle while the boat is in operation, a sudden extension force becomes applied to the tilt ram. This force causes the fluid pressure in the tilt cylinder upper chamber to increase, and the tilt piston absorber to open and release the fluid pressure into the space between the tilt piston and the free piston. As a result, the dampening effect of the tilt piston absorber and the oil lock mechanism prevent the PTT unit from damage, before the tilt piston comes in contact with the top of the tilt cylinder.

After the collision, a force to return the outboard motor to its original position is generated due to the weight of the outboard and the thrust of the propeller.

The PTT fluid passes through the shock return valve of the tilt piston, via the free piston, and into the tilt cylinder upper chamber.

When the tilt piston comes in contact with the free piston, the tilt piston stops.

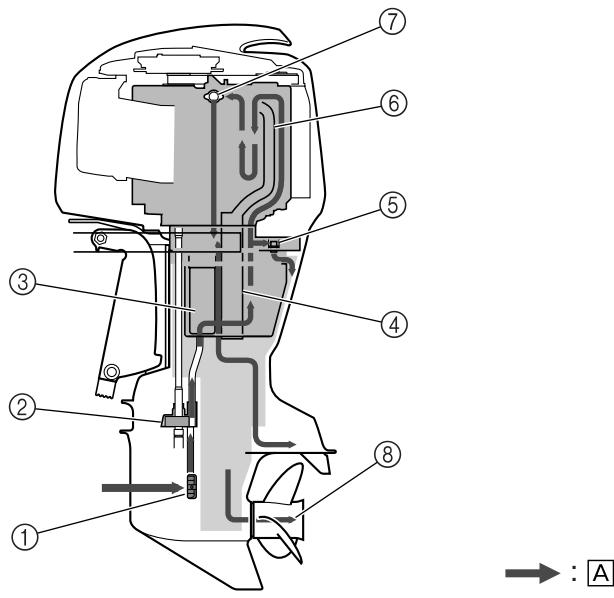


S69J1450

- ① Tilt ram
- ② Tilt cylinder
- ③ Tilt piston absorber

- ④ Tilt piston
- ⑤ Shock return valve
- ⑥ Free piston

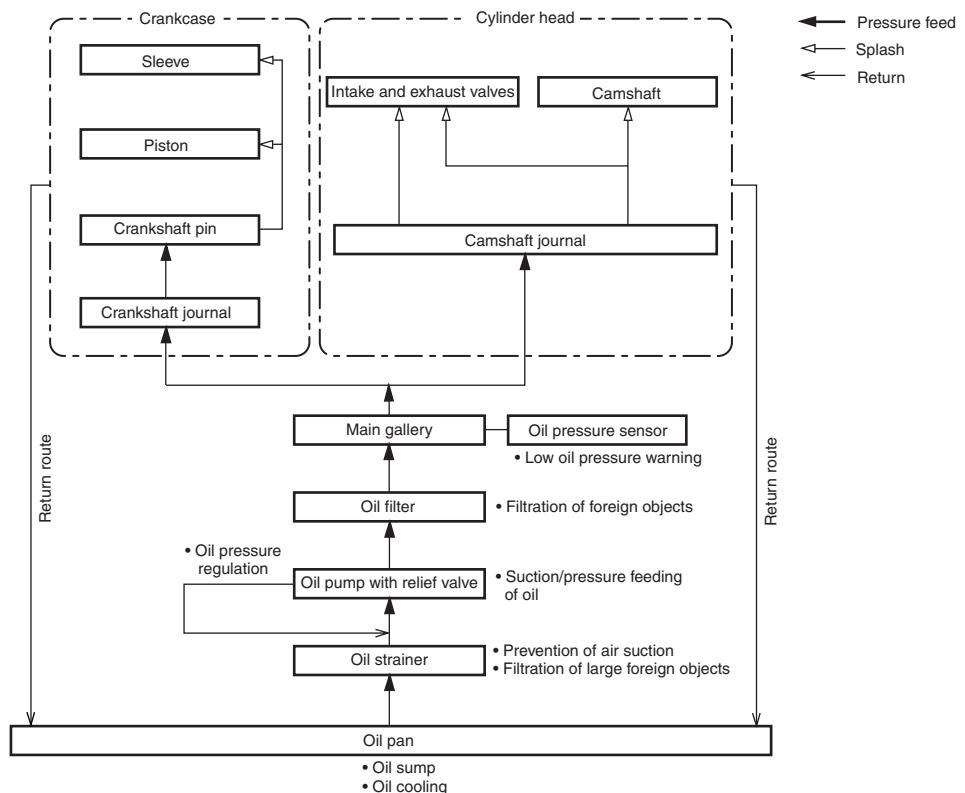
## Cooling system



S69J1460

- |                                |                          |
|--------------------------------|--------------------------|
| ① Cooling water inlet          | ⑥ In-bank exhaust system |
| ② Water pump                   | ⑦ Thermostat             |
| ③ Oil pan                      | ⑧ Propeller boss         |
| ④ Exhaust pipe                 | [A] Water                |
| ⑤ PCV (Pressure control valve) |                          |

## Lubrication system



S69J1470



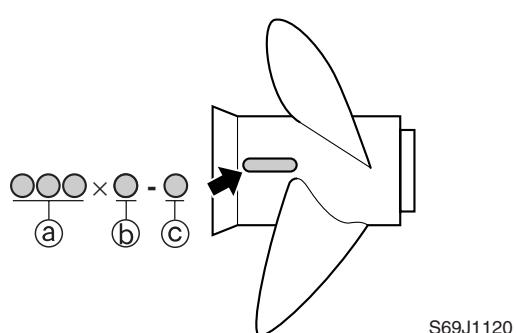
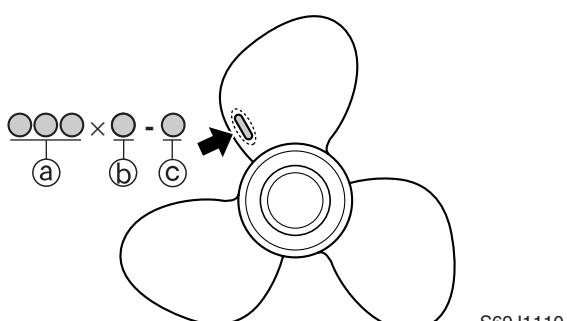
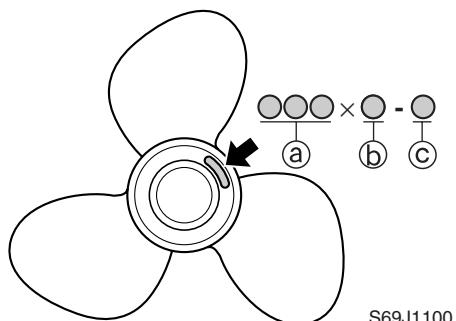
## Propeller selection

The performance of a boat and outboard motor will be critically affected by the size and type of propeller you choose. Propellers greatly affect boat speed, acceleration, engine life, fuel economy, and even boating and steering capabilities. An incorrect choice could adversely affect performance and could also seriously damage the engine.

Use the following information as a guide for selecting a propeller that meets the operating conditions of the boat and the outboard motor.

### Propeller size

The size of the propeller is indicated on the propeller blade or outside of the propeller boss.



- ⓐ Propeller diameter (in inches)
- ⓑ Propeller pitch (in inches)
- ⓒ Propeller type (propeller mark)

### Selection

When the engine speed is at the full throttle operating range (5,000–6,000 r/min), the ideal propeller for the boat is one that provides maximum performance in relation to boat speed and fuel consumption.

### Regular rotation model

Propeller size (in)	Material
13 3/4 × 17 - M	Stainless
13 3/4 × 19 - M	
13 3/4 × 21 - M	
14 1/2 × 15 - M	
14 1/2 × 19 - T	
14 1/2 × 21 - T	
14 7/8 × 21 - M	
14 7/8 × 23 - M	
15 × 17 - T	
15 1/4 × 15 - M	
15 1/4 × 17 - M	
15 1/4 × 19 - M	

### Counter rotation model

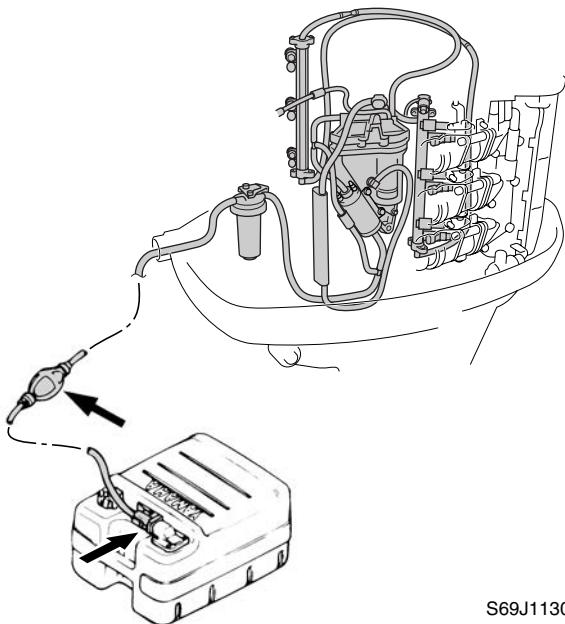
Propeller size (in)	Material
13 3/4 × 17 - ML	Stainless
13 3/4 × 19 - ML	
13 3/4 × 21 - ML	
14 1/2 × 15 - ML	
14 1/2 × 19 - TL	
14 1/2 × 21 - TL	
14 7/8 × 21 - ML	
14 7/8 × 23 - ML	
15 × 17 - TL	
15 1/4 × 15 - ML	
15 1/4 × 17 - ML	
15 1/4 × 19 - ML	

### Predelivery checks

To make the delivery process smooth and efficient, the predelivery checks should be completed as explained below.

### Checking the fuel system

1. Check that the fuel hoses are securely connected and that the fuel tank is full with fuel.

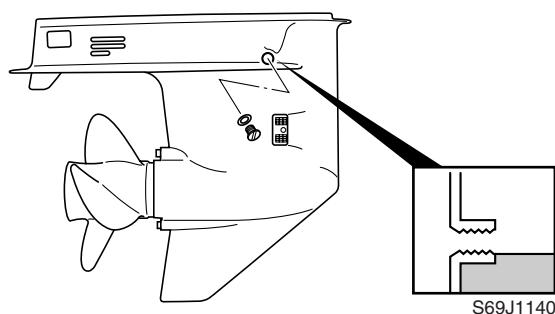


#### **CAUTION:**

This is a 4-stroke engine. Do not use pre-mixed fuel and 2-stroke outboard motor oil.

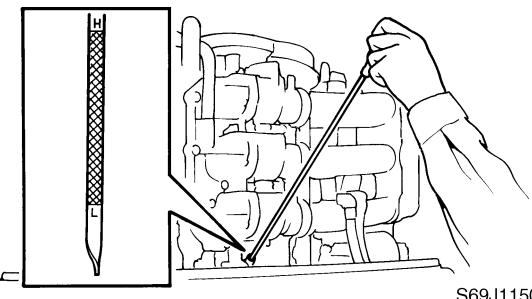
### Checking the gear oil

1. Check the gear oil level.



### Checking the engine oil

1. Check the oil level.



#### **NOTE:**

- If the engine oil is above the maximum level mark (H), drain sufficient oil until the level is between (H) and (L).
- If the engine oil is below the minimum level mark (L), add sufficient oil until the level is between (H) and (L).



Recommended engine oil:  
4-stroke motor oil  
API: SE, SF, SG, SH, or SJ  
SAE: 10W-30 or 10W-40  
Oil capacity:  
Without oil filter replacement:  
5.8 L (6.1 US qt, 5.1 Imp qt)

### Checking the battery

1. Check the capacity, electrolyte level, and specified gravity of the battery.



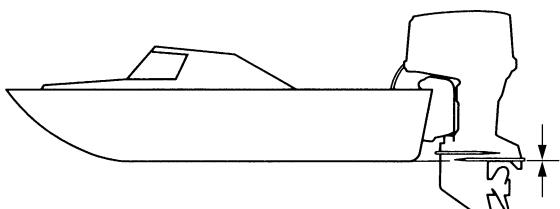
Recommended battery capacity:  
CCA/SAE: 512 A  
MCA/ABYC: 675 A  
RC/SAE: 182 Minute  
Electrolyte specified gravity:  
1.280 at 20 °C (68 °F)

2. Check that the red and black battery cables are securely connected.

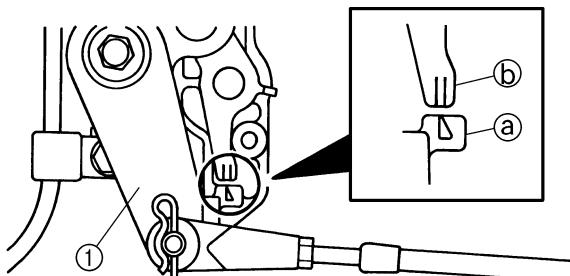


## Checking the outboard motor mounting height

- Check that the anti-cavitation plate is aligned with the bottom of the boat. If the mounting height is too high, cavitation will occur and propulsion will be reduced. Also, the engine speed will increase abnormally and cause the engine to overheat. If the mounting height is too low, water resistance will increase and reduce engine efficiency.

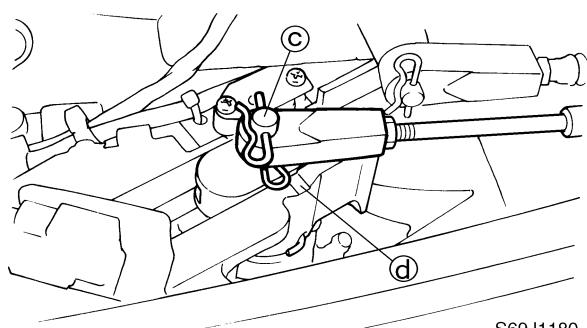


S69J1160

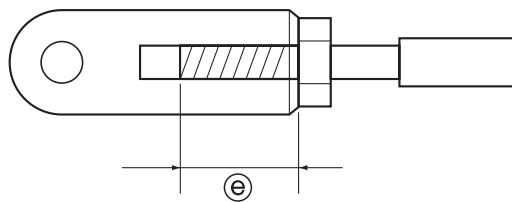


S69J1170

- Check that the set pin (C) is in the center of the shift bracket and aligned with the alignment mark (d) on the bracket.



S69J1180



S69J1190

### NOTE:

The optimum mounting height is affected by the combination of the boat and the outboard motor. To determine the optimum mounting height, test run the outboard motor at different heights.

- Check that the clamp brackets are secured with the clamp bolts.

## Checking the remote control cables

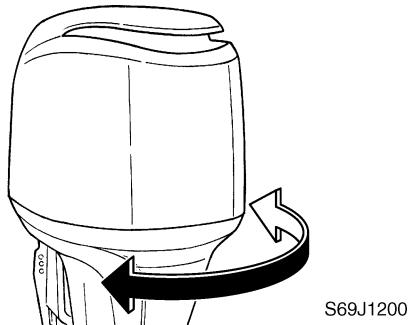
- Set the remote control lever to the neutral position and fully close the throttle lever.
- Check that the throttle cam (①) is in its fully close position and the alignment mark (a) is between the alignment mark (b).

### CAUTION:

The shift/throttle cable joint must be screwed in a minimum of 8.0 mm (0.31 in) (E).

### Checking the steering wheel

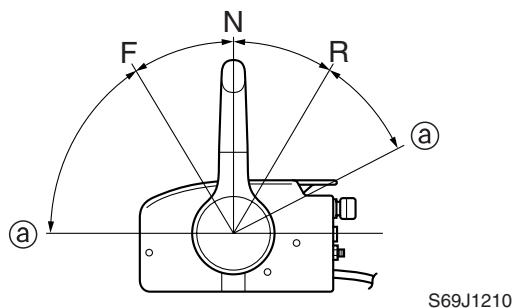
1. Check the steering friction for proper adjustment.
2. Check that the steering operates smoothly.



3. Check that there is no interference with wires or hoses when the outboard motor is steered.

### Checking the gearshift and throttle operation

1. Check that the gearshift operates smoothly when the remote control lever is shifted from neutral into forward or reverse.
2. Check that the throttle operates smoothly when the remote control lever is shifted from the fully closed position to the fully open position ②.

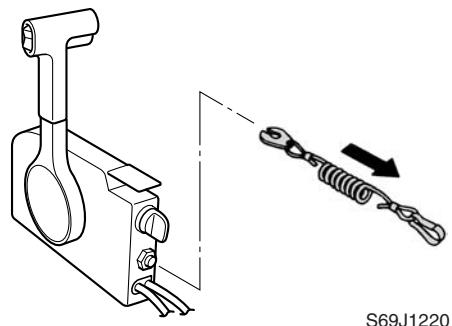


### Checking the tilt system

1. Check that the outboard motor tilts up and down smoothly when operating the power trim and tilt unit.
2. Check that there is no abnormal noise produced when the outboard motor is tilted up or down.
3. Check that there is no interference with wires and hoses when the tilted-up outboard motor is steered.
4. Check that the trim meter points down when the outboard motor is tilted all the way down.

### Checking the engine start switch and engine stop lanyard switch

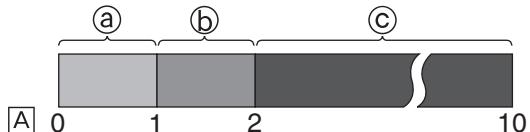
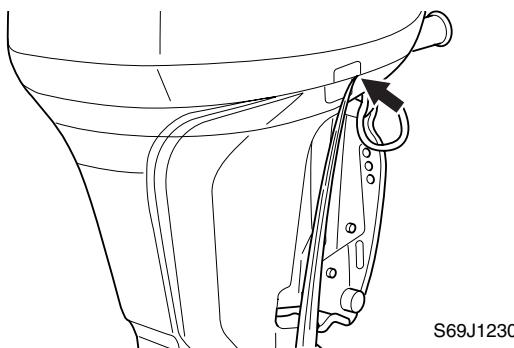
1. Check that the engine starts when the engine start switch is turned to START.
2. Check that the engine turns off when the engine start switch is turned to OFF.
3. Check that the engine turns off when the engine stop lanyard is pulled from the engine stop lanyard switch.





## Checking the cooling water pilot hole

1. Check that cooling water is discharged from the cooling water pilot hole.



[A] Hour

### After test run

1. Start the engine, and then check that the gearshift operates smoothly.
2. Check the engine idle speed after the engine has been warmed up.
3. Operate at trolling speed.
4. Run the outboard motor for one hour at 2,000 r/min or at half throttle, then for another hour at 3,000 r/min or at 3/4 throttle.
5. Check that the outboard motor does not tilt up when shifting into reverse and that water does not flow in over the transom.

#### NOTE:

The test run is part of the break-in operation.

## Break-in

During the test run, perform the break-in operation in the following three stages.

1. One hour ① at 2,000 r/min or at approximately half throttle.
2. One hour ② at 3,000 r/min or 3/4 throttle and one minute out of every ten at full throttle.
3. Eight hours ③ at any speed, however, avoid running at full speed for more than five minutes.



## Specifications

<b>General specifications.....</b>	<b>2-1</b>
<b>Maintenance specifications .....</b>	<b>2-3</b>
Power unit.....	2-3
Lower unit .....	2-6
Electrical .....	2-7
Dimensions.....	2-11
<b>Tightening torques.....</b>	<b>2-14</b>
Specified torques.....	2-14
General torques.....	2-17

**SPEC**

## Specifications

### General specifications

Item	Unit	Model								
		F200TR	LF200TR	F225TR	LF225TR					
<b>Dimension</b>										
Overall length	mm (in)	892 (35.1)								
Overall width	mm (in)	634 (25.0)								
Overall height (X)	mm (in)	1,805 (71.1)								
(U)	mm (in)	—		1,932 (76.1)						
Boat transom height (X)	mm (in)	635 (25.0)								
(U)	mm (in)	—		762 (30.0)						
<b>Weight</b>										
(without propeller) (X)	kg (lb)	265 (584)								
(U)	kg (lb)	—		271 (597)						
<b>Performance</b>										
Maximum output	kW (hp) at 5,500 r/min	147.1 (200)		165.5 (225)						
Full throttle operating range	r/min	5,000–6,000								
Maximum fuel consumption	L (US gal, Imp gal)/hr at 6,000 r/min	66.0 (17.4, 14.5)		70.0 (18.5, 15.4)						
<b>Power unit</b>										
Type		V6, 4-stroke, DOHC, 24 valves								
Cylinder quantity		6								
Displacement	cm <sup>3</sup> (cu. in)	3,352 (204.5)								
Bore × stroke	mm (in)	94.0 × 80.5 (3.70 × 3.17)								
Compression ratio		9.9								
Control system		Remote control								
Starting system		Electric								
Ignition control system		Microcomputer (TCI)								
Ignition timing	Degree	TDC–BTDC 21	TDC–BTDC 24							
Alternator output	V, A	12, 45								
Spark plugs		LFR5A-11 (NGK)								
Cooling system		Water								
Exhaust system		Through propeller boss								
Lubrication system		Wet sump								

## General specifications

2

Item	Unit	Model			
		F200TR	LF200TR	F225TR	LF225TR
<b>Fuel and oil</b>					
Fuel type	PON <sup>(*)1)</sup>	Regular unleaded gasoline			
Fuel rating	RON	86			
Engine oil type	API	91			
Engine oil grade	SAE	4-stroke motor oil SE, SF, SG, SH, or SJ 10W-30 or 10W-40			
Engine oil quantity (with oil filter replacement)	L (US qt, Imp qt)	6.0 (6.3, 5.3)			
(without oil filter replacement)	L (US qt, Imp qt)	5.8 (6.1, 5.1)			
Gear oil type	SAE	GEAR CASE LUBE			
Gear oil grade		90			
Gear oil quantity	L (US qt, Imp qt)	1.15 (1.22, 1.01)	1.00 (1.06, 0.88)	1.15 (1.22, 1.01)	1.00 (1.06, 0.88)
<b>Bracket</b>					
Trim angle (at 12 degree boat transom)	Degree	-3–16			
Tilt-up angle	Degree	70			
Steering angle	Degree	32 + 32			
<b>Drive unit</b>					
Gearshift positions		F-N-R			
Gear ratio		2.00 (30/15)			
Reduction gear type		Spiral bevel gear			
Clutch type		Dog clutch			
Propeller shaft type		Spline			
Propeller direction (rear view)		Clockwise T, M	Counter-clockwise TL, ML	Clockwise T, M	Counter-clockwise TL, ML
Propeller identification mark					
<b>Electrical</b>					
Battery minimum capacity <sup>(*)2)</sup>	A				
CCA/SAE	A	512			
MCA/ABYC		675			
RC/SAE	Minute	182			

(\*)1) PON: Pump Octane Number = (RON + Motor Octane Number)/2

RON: Research Octane Number

(\*)2) CCA: Cold Cranking Ampere

MCA: Marine Cranking Ampere

ABYC: American Boat and Yacht Council

SAE: Society of Automotive Engineers

RC: Reserve Capacity

**Maintenance specifications****Power unit**

Item	Unit	Model			
		F200TR	LF200TR	F225TR	LF225TR
<b>Power unit</b>					
Minimum compression pressure <sup>(*)1)</sup>	kPa (kgf/cm <sup>2</sup> , psi)			880 (8.8, 125)	
Lubrication oil pressure <sup>(*)2)</sup>	kPa (kgf/cm <sup>2</sup> , psi) at 700 r/min			650 (6.5, 924)	
<b>Cylinder heads</b>					
Warpage limit	mm (in)			0.1 (0.004)	
(lines indicate straightedge position)					
Camshaft cap inside diameter	mm (in)			25.00–25.02 (0.9843–0.9850)	
<b>Cylinders</b>					
Bore size	mm (in)			94.00–94.02 (3.7008–3.7016)	
Taper limit	mm (in)			0.08 (0.0032)	
Out-of-round limit	mm (in)			0.05 (0.0020)	
<b>Pistons</b>					
Piston diameter (D)	mm (in)			93.921–93.941 (3.6977–3.6985)	
Measuring point (H)	mm (in)			5 (0.2)	
Piston-to-cylinder clearance	mm (in)			0.075–0.080 (0.0029–0.0031)	
Piston pin boss bore	mm (in)			21.02–21.03 (0.8276–0.8280)	
<b>Piston pins</b>					
Outside diameter	mm (in)			21.00 (0.827)	
<b>Piston rings</b>					
Top ring					
Dimension B	mm (in)			1.17–1.19 (0.0461–0.0468)	
Dimension T	mm (in)			2.8–3.0 (0.110–0.118)	
End gap	mm (in)			0.15–0.30 (0.0059–0.0118)	
Side clearance	mm (in)			0.04–0.08 (0.0016–0.0031)	

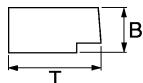
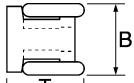
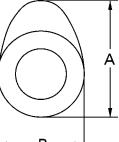
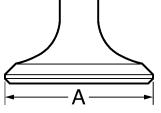
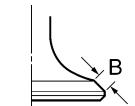
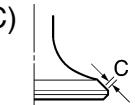
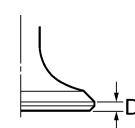
<sup>(\*)1)</sup> Measure conditions:

Ambient temperature 20 °C (68 °F), wide open throttle, with spark plugs removed from all cylinders.

The figures are for reference only.

<sup>(\*)2)</sup> The figures are for reference only.

## Maintenance specifications

Item	Unit	Model			
		F200TR	LF200TR	F225TR	LF225TR
2nd ring					
Dimension B		mm (in)	1.17–1.19 (0.0461–0.0468)		
Dimension T		mm (in)	3.6–3.8 (0.142–0.150)		
End gap		mm (in)	0.30–0.45 (0.0118–0.0177)		
Side clearance		mm (in)	0.03–0.07 (0.0012–0.0027)		
Oil ring					
Dimension B		mm (in)	2.40–2.47 (0.0945–0.0972)		
Dimension T		mm (in)	2.3–2.7 (0.091–0.106)		
End gap		mm (in)	0.15–0.60 (0.0059–0.0236)		
Side clearance		mm (in)	0.04–0.13 (0.0016–0.0051)		
<b>Camshafts</b>					
Intake (A)		mm (in)	45.30–45.40 (1.7835–1.7874)		
Exhaust (A)		mm (in)	45.35–45.45 (1.7854–1.7894)		
Intake and exhaust (B)		mm (in)	35.95–36.05 (1.4154–1.4193)		
Camshaft journal diameter		mm (in)	24.96–24.98 (0.9827–0.9834)		
Camshaft journal oil clearance		mm (in)	0.02–0.06 (0.0008–0.0023)		
Camshaft runout limit		mm (in)	0.03 (0.0012)		
<b>Valves</b>					
Valve clearance (cold)					
Intake		mm (in)	0.20 ± 0.03 (0.008 ± 0.001)		
Exhaust		mm (in)	0.34 ± 0.03 (0.013 ± 0.001)		
Head diameter (A)		mm (in)	34.85–35.15 (1.3720–1.3839)		
Intake		mm (in)	29.85–30.15 (1.1752–1.1870)		
Face width (B)		mm (in)	2.11 (0.0831)		
Intake		mm (in)	2.43 (0.0957)		
Seat contact width (C)		mm (in)	1.1–1.4 (0.043–0.055)		
Intake		mm (in)	1.4–1.7 (0.055–0.067)		
Margin thickness (D)		mm (in)	0.7 (0.028)		
Intake		mm (in)	1.0 (0.039)		
Stem diameter					
Intake		mm (in)	5.477–5.492 (0.2156–0.2162)		
Exhaust		mm (in)	5.464–5.479 (0.2151–0.2157)		
Guide inside diameter					
Intake and exhaust		mm (in)	5.504–5.522 (0.2167–0.2174)		
Stem-to-guide clearance					
Intake and exhaust		mm (in)	0.025–0.058 (0.0010–0.0023)		
Stem runout limit					
Intake and exhaust		mm (in)	0.01 (0.0004)		

**SPEC****Specifications**

Item	Unit	Model			
		F200TR	LF200TR	F225TR	LF225TR
<b>Valve springs</b>					
Free length	mm (in)		44.20 (1.740)		
Minimum free length	mm (in)		42.60 (1.677)		
Tilt limit	mm (in)		1.5 (0.06)		
<b>Valve lifters</b>					
Valve lifter outside diameter	mm (in)		32.98–33.00 (1.2984–1.2992)		
Valve lifter-to-cylinder head clearance	mm (in)		0.02–0.05 (0.0008–0.0020)		
<b>Valve shims</b>					
Valve shim thickness (in 0.020 mm increments)	mm (in)		2.320–2.960 (0.0913–0.1165)		
<b>Connecting rods</b>					
Small-end inside diameter	mm (in)		21.00 (0.827)		
Big-end inside diameter	mm (in)		53.00 (2.087)		
Crankpin oil clearance	mm (in)		0.035–0.071 (0.0014–0.0028)		
Big-end bearing thickness					
Yellow	mm (in)		1.492–1.496 (0.0587–0.0588)		
Green	mm (in)		1.496–1.500 (0.0588–0.0591)		
Blue	mm (in)		1.500–1.504 (0.0591–0.0592)		
<b>Crankshaft</b>					
Crankshaft journal diameter	mm (in)		62.968–62.992 (2.4791–2.4800)		
Crankpin diameter	mm (in)		49.976–50.000 (1.9676–1.9685)		
Crankpin width	mm (in)		21.50–21.55 (0.8465–0.8484)		
Runout limit	mm (in)		0.03 (0.0012)		
<b>Crankcase</b>					
Crankshaft main journal oil clearance	mm (in)		0.025–0.050 (0.0010–0.0020)		
Upper crankcase main journal bearing thickness					
1	mm (in)		2.494–2.500 (0.0981–0.0984)		
2	mm (in)		2.498–2.504 (0.0983–0.0986)		
3	mm (in)		2.502–2.508 (0.0985–0.0987)		
Lower crankcase main journal bearing thickness					
1	mm (in)		2.494–2.500 (0.0981–0.0984)		
2	mm (in)		2.498–2.504 (0.0983–0.0986)		
3	mm (in)		2.502–2.508 (0.0985–0.0987)		
#3 main journal bearing thickness (lower)					
1	mm (in)		2.492–2.500 (0.0980–0.0984)		
2	mm (in)		2.496–2.504 (0.0982–0.0986)		
3	mm (in)		2.500–2.508 (0.0984–0.0987)		

## Maintenance specifications

2

Item	Unit	Model			
		F200TR	LF200TR	F225TR	LF225TR
<b>Oil pump</b>					
Discharge at 97–103 °C (207–217 °F) with 10W-40 engine oil	L (US gal, Imp gal)/min at 700 r/min			8.8 (2.32, 1.94)	
Pressure	kPa (kgf/cm <sup>2</sup> , psi)			138 (1.38, 19.62)	
Relief valve opening pressure	kPa (kgf/cm <sup>2</sup> , psi)			529–647 (5.29–6.47, 75.22–92.00)	
<b>Thermostats</b>					
Opening temperature	°C (°F)			58–62 (136–144)	
Fully open temperature	°C (°F)			70 (158)	
Valve open lower limit	mm (in)			4.3 (0.17)	
<b>Engine speed</b>					
Engine idle speed	r/min			650–750	

### Lower unit

Item	Unit	Model			
		F200TR	LF200TR	F225TR	LF225TR
<b>Gear backlash</b>					
Pinion-to-forward gear	mm (in)	0.21–0.44 (0.008– 0.017)	0.35–0.70 (0.014– 0.028)	0.21–0.44 (0.008– 0.017)	0.35–0.70 (0.014– 0.028)
Pinion-to-reverse gear	mm (in)		0.70–1.03 (0.028–0.041)		
Pinion shims	mm		0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50		
Forward gear shims	mm		0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50		
Reverse gear shims	mm		0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50		
Propeller shaft shims	mm	—	0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50	—	0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50



## Electrical

Item	Unit	Model			
		F200TR	LF200TR	F225TR	LF225TR
<b>Ignition and ignition control system</b>					
Pulser coil output peak voltage (W/R – B, W/B – B, W/G – B)	V				
at cranking (unloaded)	V	5.3			
at cranking (loaded)	V	5.3			
at 1,500 r/min (loaded)	V	20			
at 3,500 r/min (loaded)	V	43			
Pulser coil resistance <sup>(*)1</sup> (W/R – B, W/B – B, W/G – B)	Ω			459–561	
ECM output peak voltage (B/O – B, B/Y – B, B/W – B)	V				
at cranking (loaded)	V	252			
at 1,500 r/min (loaded)	V	260			
at 3,500 r/min (loaded)	V	260			
Spark plug gap	mm (in)			1.0–1.1 (0.039–0.043)	
Ignition coil resistance					
Primary coil (R/Y – B/O, R/Y – B/Y, R/Y – B/W)	Ω			1.5–1.9	
Secondary coil (spark plug wire – spark plug wire)	kΩ			19.6–35.4	
Throttle position sensor output voltage (P – B)	mV			695–705	
Oil pressure sensor output voltage (engine idle speed) (O – B)	V			3.8	
Intake air temperature sensor resistance					
at 0 °C (32 °F)	kΩ			5.4–6.6	
at 80 °C (176 °F)	kΩ			0.29–0.39	
Engine temperature sensor resistance (B/Y – B)					
at 20 °C (68 °F)	kΩ			54.2–69.0	
at 100 °C (212 °F)	kΩ			3.12–3.48	
Thermoswitch continuity temperature (P – B)					
ON	°C (°F)			84–90 (183–194)	
OFF	°C (°F)			68–82 (154–179)	

(\*)1 The figures are for reference only.

## Maintenance specifications

2

Item	Unit	Model			
		F200TR	LF200TR	F225TR	LF225TR
<b>Fuel control system</b>					
Fuel injector resistance <sup>(*)1)</sup> at 20 °C (68 °F)	Ω	14.0–15.0			
<b>Starter motor</b>					
Type		Sliding gear			
Output	kW	1.4			
Cranking time limit	Second	30			
Brushes					
Standard length	mm (in)	15.5 (0.61)			
Wear limit	mm (in)	9.5 (0.37)			
Commutator					
Standard diameter	mm (in)	29.0 (1.14)			
Wear limit	mm (in)	28.0 (1.10)			
Mica					
Standard undercut	mm (in)	0.5–0.8 (0.02–0.03)			
Wear limit	mm (in)	0.2 (0.01)			
<b>Charging system</b>					
Fuse	A	5, 20, 30			
Stator coil output peak voltage (G – G)					
at cranking (unloaded)	V	10			
at 1,500 r/min (unloaded)	V	42			
at 3,500 r/min (unloaded) (G/W – G/W)	V	93			
at cranking (unloaded)	V	9.0			
at 1,500 r/min (unloaded)	V	34			
at 3,500 r/min (unloaded)	V	78			
Stator coil resistance <sup>(*)1)</sup>					
(G – G)	Ω	0.28–0.42, 0.24–0.36			
(G/W – G/W)	Ω	0.24–0.36, 0.20–0.31			
Rectifier Regulator output peak voltage (R – B, R/Y – B)					
at 1,500 r/min (unloaded)	V	13			
at 3,500 r/min (unloaded)	V	13			

(\*)1) The figures are for reference only.

**SPEC****Specifications**

Item	Unit	Model			
		F200TR	LF200TR	F225TR	LF225TR
<b>Power trim and tilt system</b>					
Trim sensor					
Setting resistance	Ω			9–11	
Resistance (P – B)	Ω			9–387.6	
Fluid type				ATF Dexron II	
Brushes					
Standard length	mm (in)			12.0 (0.47)	
Wear limit	mm (in)			4.0 (0.16)	
Commutator					
Standard diameter	mm (in)			25.0 (0.98)	

**— MEMO —**

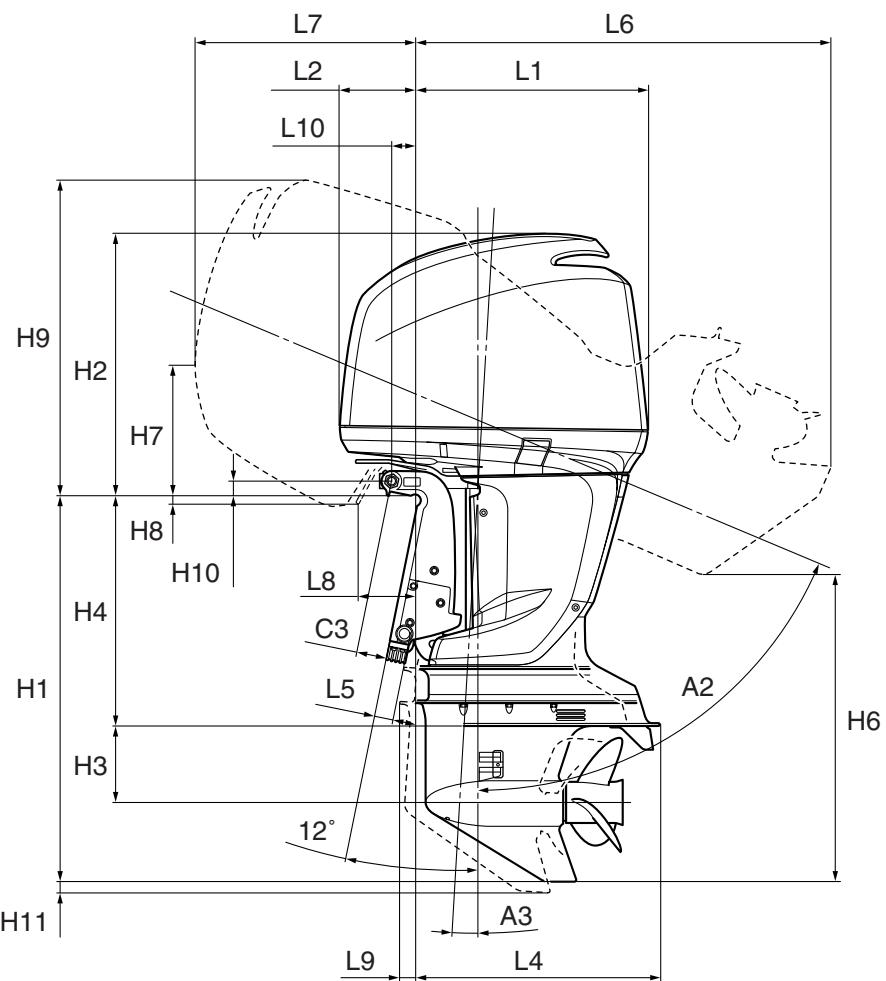
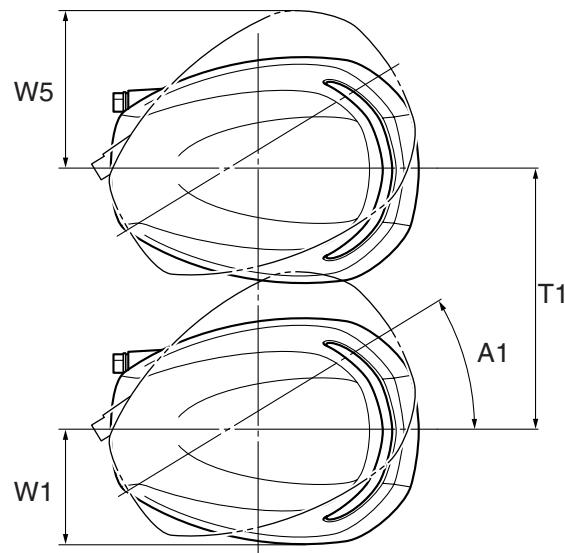
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**SPEC**

## Specifications

### Dimensions

#### Exterior



S69J2130

## Maintenance specifications

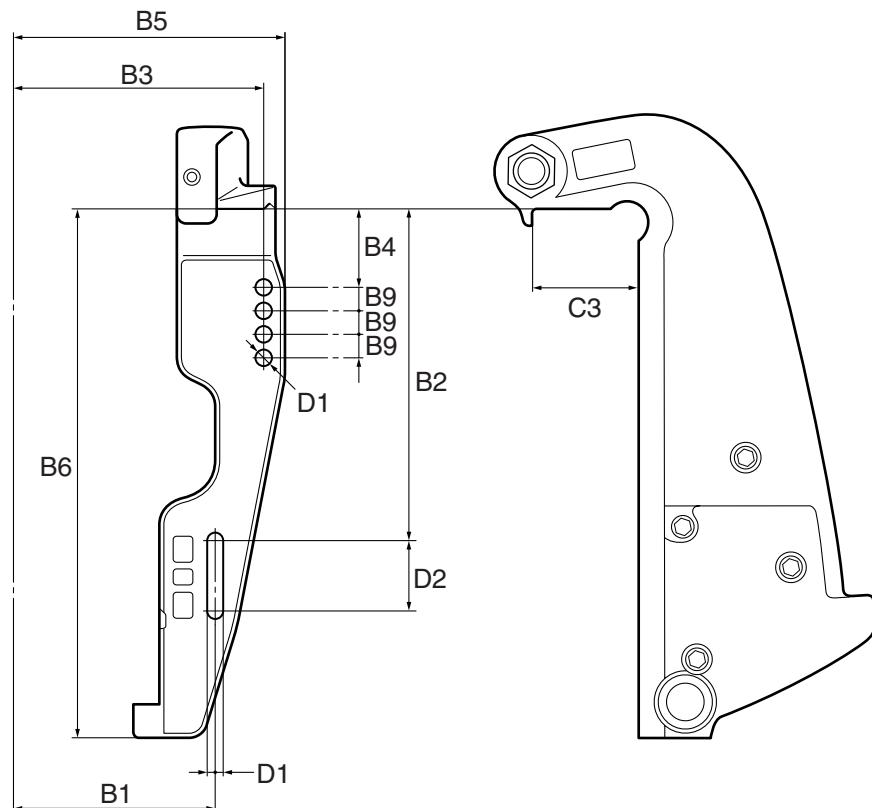
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Symbol	Unit	Model			
		F200TR	LF200TR	F225TR	LF225TR
L1	mm (in)			651 (25.6)	
L2	mm (in)			219 (8.6)	
L3	mm (in)			—	
L4	mm (in)			673 (26.5)	
L5	(X) mm (in)			59 (2.3)	
	(U) mm (in)	—		59 (2.3)	
L6	(X) mm (in)			1,155 (45.5)	
	(U) mm (in)	—		1,272 (50.1)	
L7	mm (in)			618 (24.3)	
L8	mm (in)			230 (9.1)	
L9	(X) mm (in)			52 (2.0)	
	(U) mm (in)	—		59 (2.3)	
L10	mm (in)			75 (3.0)	
H1	(X) mm (in)			1,078 (42.4)	
	(U) mm (in)	—		1,205 (47.4)	
H2	mm (in)			727 (28.6)	
H3	mm (in)			216 (8.5)	
H4	(X) mm (in)			643 (25.3)	
	(U) mm (in)	—		770 (30.3)	
H5	mm (in)			—	
H6	(X) mm (in)			847 (33.3)	
	(U) mm (in)	—		924 (36.4)	
H7	mm (in)			361 (14.2)	
H8	mm (in)			39 (1.5)	
H9	mm (in)			880 (34.6)	
H10	mm (in)			45 (1.8)	
H11	(X) mm (in)			25 (1.0)	
	(U) mm (in)	—		25 (1.0)	
W1	mm (in)			317 (12.5)	
W2	mm (in)			—	
W3	mm (in)			—	
W4	mm (in)			—	
W5	mm (in)			453 (17.8)	
W6	mm (in)			—	
A1	Degree			32	
A2	Degree			70	
A3	Degree			3	
T1	mm (in)			724 (28.5)	

**SPEC**

## Specifications

### Clamp bracket



S69J2140

Symbol	Unit	Model			
		F200TR	LF200TR	F225TR	LF225TR
B1	mm (in)			125 (4.9)	
B2	mm (in)			254 (10.0)	
B3	mm (in)			163 (6.4)	
B4	mm (in)			51 (2.0)	
B5	mm (in)			180 (7.1)	
B6	mm (in)			411 (16.2)	
B7	mm (in)			—	
B8	mm (in)			—	
B9	mm (in)			19 (0.7)	
C2	mm (in)			—	
C3	mm (in)			79 (3.1)	
D1	mm (in)			13 (0.5)	
D2	mm (in)			56 (2.2)	

## Maintenance specifications / Tightening torques

### Tightening torques

#### Specified torques

Part to be tightened	Thread size	Tightening torques			
		N·m	kgf·m	ft·lb	
<b>Fuel system</b>					
Fuel filter holder bolt	M6	8	0.8	5.8	
Fuel filter bracket bolt	M6	8	0.8	5.8	
Intake air temperature sensor	—	4	0.4	2.9	
Low-pressure fuel pump bracket bolt	M5	5	0.5	3.6	
Fuel cooler nut	—	5	0.5	3.6	
Float chamber bracket bolt	M8	7	0.7	5.1	
Vapor separator cover screw	M4	2	0.2	1.4	
Link rod nut	—	4	0.4	2.9	
Magnet control lever joint	—	4	0.4	2.9	
Throttle cam bolt	—	8	0.8	5.8	
<b>Power unit</b>					
PTT motor lead bolt	M6	4	0.4	2.9	
Upper case cover bolt	M6	8	0.8	5.8	
Apron bolt	M6	8	0.8	5.8	
Power unit bolt	M9 • M10	42	4.2	30	
Flywheel magnet nut	—	240	24	174	
PTT relay nut	—	4	0.4	2.9	
Starter relay lead bolt	M6	4	0.4	2.9	
Battery cable nut	—	9	0.9	6.5	
Starter motor bolt	M8	29	2.9	21	
Rectifier Regulator	1st	M6	6	0.6	4.3
	2nd		12	1.2	8.7
Link rod nut	—	4	0.4	2.9	
Oil pressure sensor	—	18	1.8	13	
Oil filter union bolt	—	34	3.4	25	
Oil filter	—	18	1.8	13	
Driven sprocket bolt	M10	60	6.0	43	
Timing belt tensioner bolt	—	39	3.9	28	
Drive sprocket bolt	M5	7	0.7	5.1	
Cylinder head cover plate screw	M4	2	0.2	1.4	
Cylinder head cover bolt	1st	M6	8	0.8	5.8
	2nd		8	0.8	5.8
Camshaft cap bolt	1st	M7	8	0.8	5.8
	2nd		17	1.7	12
Exhaust cover bolt	1st	M6	6	0.6	4.3
	2nd		12	1.2	8.7
Exhaust outer cover bolt	1st	M8	14	1.4	10
	2nd		28	2.8	20
Exhaust outer cover plug	M18	55	5.5	40	
Timing chain tensioner bolt	M6	12	1.2	8.7	

2

**SPEC****Specifications**

Part to be tightened	Thread size	Tightening torques			
		N·m	kgf·m	ft·lb	
Spark plug	—	25	2.5	18	
Cylinder head bolt	1st	M10	19	1.9	14
	2nd		37	3.7	27
	3rd		90°		
	1st	M8	14	1.4	10
	2nd		28	2.8	20
Engine hanger bolt	M6	12	1.2	8.7	
Cooling water cover bolt	M6	12	1.2	8.7	
Starboard cylinder head plug	—	23	2.3	17	
Cylinder block plug	—	23	2.3	17	
Engine temperature sensor	—	15	1.5	11	
Connecting rod cap	1st	—	23	2.3	17
	2nd		48	4.8	35
	3rd		90°		
Baffle plate nut	—	12	1.2	8.7	
Crankcase cover bolt	1st	M8	14	1.4	10
	2nd		28	2.8	20
Crankcase cover plate screw	M4	2	0.2	1.4	
Oil pump screw	—	4	0.4	2.9	
Crankcase stud bolt	1st	M8	25	2.5	18
	2nd		90°		
Crankcase bolt	1st	M10	40	4.0	29
	2nd		90°		
	1st	M8	14	1.4	10
	2nd		28	2.8	20
<b>Lower unit (regular rotation model)</b>					
Trim tab bolt	M10	43	4.3	31	
Lower unit bolt	M10	47	4.7	34	
Propeller nut	—	55	5.5	40	
Propeller shaft housing grease nipple	—	6	0.6	4.3	
Propeller shaft housing bolt	M8	30	3.0	22	
Pinion nut	—	142	14.2	103	
<b>Lower unit (counter rotation model)</b>					
Trim tab bolt	M10	43	4.3	31	
Lower unit bolt	M10	47	4.7	34	
Propeller nut	—	55	5.5	40	
Ring nut	—	108	10.8	78	
Propeller shaft housing bolt	M8	30	3.0	22	
Propeller shaft housing grease nipple	—	6	0.6	4.3	
Pinion nut	—	142	14.2	103	
<b>Bracket unit</b>					
Shift rod detent bolt	—	18	1.8	13	
Flushing hose adapter screw	M6	5	0.5	3.6	
Upper mount bracket bolt	M10	54	5.4	39	

## Tightening torques

Part to be tightened	Thread size	Tightening torques		
		N·m	kgf·m	ft·lb
Upper case mount nut	—	72	7.2	52
Engine oil drain bolt	M14	27	2.7	19
Apron stay	—	8	0.8	5.8
Pressure control valve	—	8	0.8	5.8
Upper exhaust guide bolt	M8	20	2.0	14
	M10	42	4.2	30
Oil strainer bolt	M6	10	1.0	7.2
Oil pan bolt	M8	20	2.0	14
Exhaust manifold bolt	M8	20	2.0	14
Muffler bolt	M8	20	2.0	14
Baffle plate screw	M6	4	0.4	2.9
Clamp bracket self-locking nut	—	22	2.2	16
Friction plate screw	M6	4	0.4	2.9
Trim stopper nut	—	36	3.6	25
<b>Power trim and tilt unit</b>				
Reservoir bolt	M8	18	1.8	13
Reservoir cap	M12	7	0.7	5.1
Manual valve	—	2	0.2	1.4
Fluid pipe	—	15	1.5	11
Trim cylinder end screw	—	160	16	115
Trim piston bolt	M8	38	3.8	27
Tilt ram	—	55	5.5	40
Tilt cylinder end screw	—	90	9.0	65
Tilt piston bolt	M6	7	0.7	5.1
Gear housing bolt	M5	7	0.7	5.1
Gear housing bracket bolt	M5	7	0.7	5.1

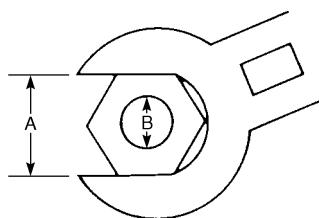


### General torques

This chart specifies tightening torques for standard fasteners with a standard ISO thread pitch. Tightening torque specifications for special components or assemblies are provided in applicable sections of this manual. To avoid warpage, tighten multi-fastener assemblies in a crisscross fashion and progressive stages until the specified torque is reached. Unless otherwise specified, torque specifications require clean, dry threads.

Components should be at room temperature.

Nut (A)	Bolt (B)	General torque specifications		
		N·m	kgf·m	ft·lb
8 mm	M5	5	0.5	3.6
10 mm	M6	8	0.8	5.8
12 mm	M8	18	1.8	13
14 mm	M10	36	3.6	25
17 mm	M12	43	4.3	31



S69J2150



## Periodic checks and adjustments

<b>Special service tools .....</b>	<b>3-1</b>
<b>Maintenance interval chart.....</b>	<b>3-2</b>
<b>Top cowling .....</b>	<b>3-4</b>
Checking the top cowling.....	3-4
<b>Fuel system .....</b>	<b>3-4</b>
Checking the fuel joint and fuel hoses (fuel joint-to-fuel injector) .....	3-4
Measuring the fuel pressure (high-pressure fuel line) .....	3-5
Checking the fuel filter .....	3-5
<b>Power unit.....</b>	<b>3-5</b>
Checking the engine oil .....	3-5
Changing the engine oil using an oil changer.....	3-6
Changing the engine oil by draining it .....	3-6
Replacing the oil filter .....	3-7
Checking the timing belt .....	3-8
Replacing the timing belt .....	3-8
Checking the valve clearance.....	3-8
Checking the spark plugs .....	3-8
Checking the thermostat.....	3-9
Checking the cooling water passage.....	3-9
<b>Control system.....</b>	<b>3-9</b>
Checking the throttle link and throttle cable operation.....	3-9
Adjusting the throttle link and throttle cable operation (with a stop bolt) ....	3-10
Adjusting the throttle link and throttle cable operation (without a stop bolt) .....	3-11
Checking the gearshift operation.....	3-12
Checking the engine idle speed .....	3-13
Checking the ignition timing.....	3-15
<b>Power trim and tilt unit .....</b>	<b>3-15</b>
Checking the power trim and tilt operation .....	3-15
Checking the power trim and tilt fluid level .....	3-16
<b>Lower unit.....</b>	<b>3-16</b>
Checking the gear oil level .....	3-16
Changing the gear oil .....	3-17
Checking the lower unit (for air leakage) .....	3-18
Checking the propeller.....	3-18
<b>General.....</b>	<b>3-18</b>
Checking the anodes.....	3-18
Checking the battery.....	3-19
Lubrication .....	3-20

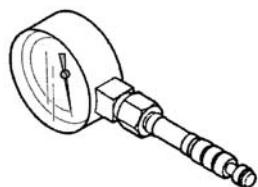
**CHK**  
**ADJ**



## Periodic checks and adjustments

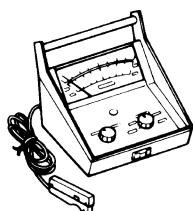
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### Special service tools



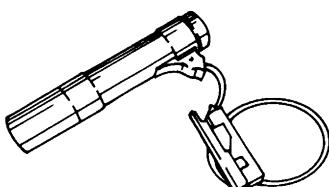
**Fuel pressure gauge**

**YB-06766**



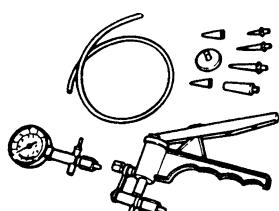
**Inductive self-powered tachometer**

**YU-08036-B**



**Battery powered timing light**

**YM-33277-A**



**Pressure/vacuum tester**

**YB-35956-A**

## Special service tools / Maintenance interval chart

### Maintenance interval chart

Use the following chart as a guideline for general maintenance.

Adjust the maintenance intervals according to the operating conditions of the outboard motor.

Item	Remarks	Initial		Every			Refer to page
		10 hours (Break-in)	50 hours (3 months)	100 hours (6 months)	200 hours (1 year)	400 hours (2 years)	
<b>Top cowling</b>							
Top cowling fit	Check			○ (before each use)			3-4
<b>Fuel system</b>							
Fuel joint and fuel hoses	Check			○ (before each use)			3-4
Fuel filter (disposable type)	Check/replace	○		○			—
Fuel filter (water separator)	Check			○ (before each use)			3-5
Fuel tank <sup>(*)1</sup>	Clean				○		—
<b>Power unit</b>							
Engine oil	Check			○ (before each use)			3-5
	Change	○		○			3-6
Oil filter	Change			○			3-7
Oil pump	Check					○	5-55
Timing chain	Check/replace			○ (1,000 hours or 5 years)			5-39
Chain tensioner	Check/replace					○	5-39
Timing belt <sup>(*)2</sup>	Check/replace				○		3-8, 5-21
Valve clearance	Check/adjust	○			○		5-15
Spark plugs	Clean/adjust/replace			○			3-8
Thermostat	Check			○			5-60
Pressure control valve	Check			○			—
Flywheel magnet nut	Check	○					—
Motor exterior	Check			○ (before each use)			—
Oil leakage	Check	○	○	○			—
Cooling water passage <sup>(*)3</sup>	Clean			○ (after each use)			3-9
<b>Control system</b>							
Throttle link	Check/adjust				○		3-9, 3-10, 3-11
Throttle cable	Check/adjust				○		3-9, 3-10, 3-11
Shift cable	Check/adjust				○		3-12
Engine idle speed	Adjust	○			○		3-13
Ignition timing	Check	○					3-15
<b>Power trim and tilt unit</b>							
Power trim and tilt unit	Check				○		3-15, 3-16

**CHK**  
**ADJ****Periodic checks and adjustments**

Item	Remarks	Initial		Every			Refer to page
		10 hours (Break-in)	50 hours (3 months)	100 hours (6 months)	200 hours (1 year)	400 hours (2 years)	
<b>Lower unit</b>							
Gear oil	Change	<input type="radio"/>		<input type="radio"/>			3-17
Impeller/Woodruff key	Check/replace			<input type="radio"/>	(500 hours or 30 months)		6-8, 6-34
Oil seals	Check/replace			<input type="radio"/>			—
Propeller	Check			<input type="radio"/>	(before each use)		3-18
<b>General</b>							
Anodes/Trim tab	Check/replace				<input type="radio"/>		3-18
Battery	Check/charge	<input type="radio"/>		<input type="radio"/>	<input type="radio"/>		3-19
Wiring and connectors	Adjust/reconnect	<input type="radio"/>		<input type="radio"/>	<input type="radio"/>		—
Nuts and bolts <sup>(*)4)</sup>	Tighten	<input type="radio"/>		<input type="radio"/>	<input type="radio"/>		—
Lubrication points	Lubricate			<input type="radio"/>			3-20

**NOTE:** \_\_\_\_\_

(\*1) If equipped with a portable fuel tank.

(\*2) Be sure to replace the timing belt every 1,000 hours of operation or every five years.

(\*3) The engine should be flushed with fresh water after operating in salt, turbid, or muddy water.

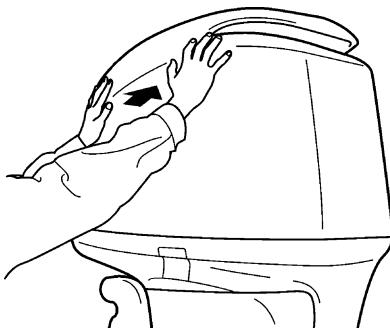
(\*4) Do not retighten the cylinder head and crankcase bolts.

## Maintenance interval chart / Top cowling / Fuel system

### Top cowling

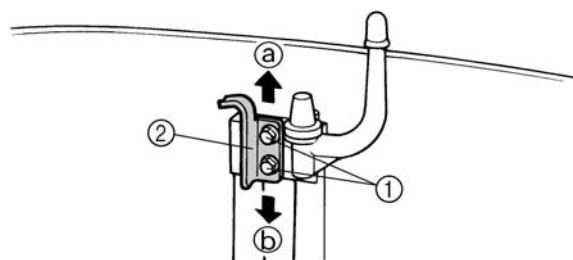
#### Checking the top cowling

1. Check the fitting by pushing the cowling with both hands. Adjust if necessary.



S69J3010

2. Loosen the bolts ①.
3. Move the hook ② up or down slightly to adjust its position.

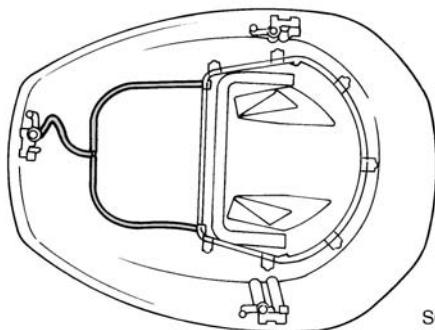


S69J3020

#### NOTE:

- To loosen the fitting, move the hook in direction ②.
- To tighten the fitting, move the hook in direction ①.

4. Tighten the bolts.
5. Check the fitting again and, if necessary, repeat steps 2–4.
6. Check the top cowling hose for cracks or damage. Replace if necessary.



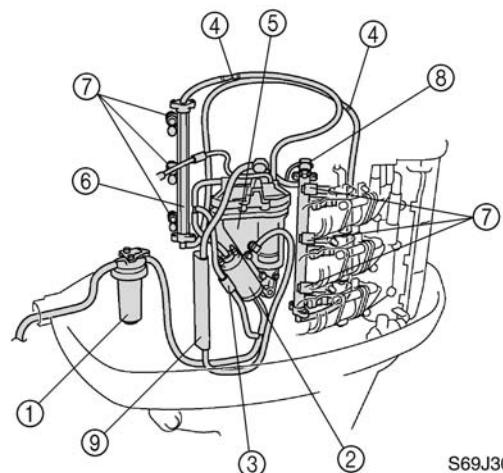
S69J3030

**3**

### Fuel system

#### Checking the fuel joint and fuel hoses (fuel joint-to-fuel injector)

1. Remove the flywheel magnet cover and intake silencer.
2. Check the low-pressure fuel hose connections and fuel joint for leaks. Replace if necessary. Also, check the fuel filter ①, low-pressure fuel pump ②, and check valve ③ for leaks and deterioration. Replace if necessary.
3. Check the high-pressure fuel hose connections and fuel joint ④ for leaks. Replace if necessary. Also, check the vapor separator ⑤, fuel rail ⑥, fuel injector ⑦, pressure regulator ⑧, and fuel cooler ⑨ for leaks and deterioration. Replace if necessary.



S69J3040

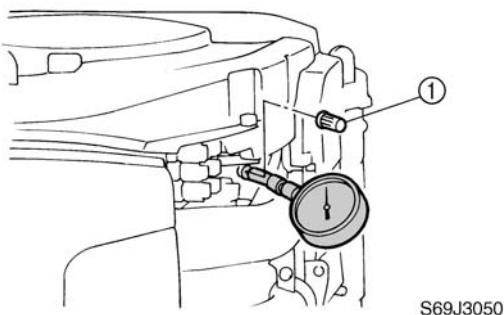
**CHK  
ADJ**

## Periodic checks and adjustments

### Measuring the fuel pressure

#### (high-pressure fuel line)

1. Remove the cap ①.
2. Install the fuel pressure gauge onto the pressure check valve.



Fuel pressure gauge: YB-06766

3. Turn the engine start switch to ON, and then measure the fuel pressure.

**NOTE:**

After the engine start switch is turned to ON, the fuel pressure will decrease gradually.



Fuel pressure:  
310 kPa (3.1 kgf/cm<sup>2</sup>, 44 psi)

4. Start the engine and warm it up for 5 minutes, and then measure the fuel pressure.

**NOTE:**

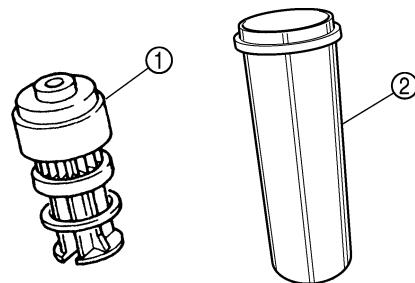
The pressure regulator can be checked since the fuel pressure (310 kPa [3.1 kgf/cm<sup>2</sup>, 44 psi]), from when the engine switch is turned to ON, decreases when the engine is idling.



Fuel pressure:  
270 kPa (2.7 kgf/cm<sup>2</sup>, 38 psi)

### Checking the fuel filter

1. Check the fuel filter element ① for dirt and residue and check the fuel filter cup ② for foreign substances and cracks. Clean with straight gasoline and replace the cup if necessary.



S69J3070

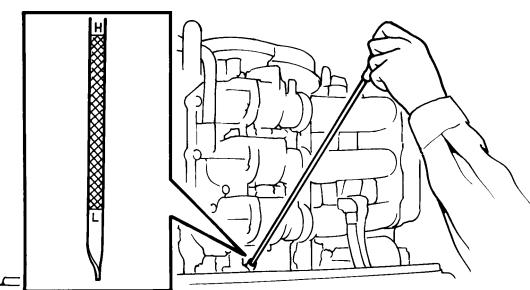
**NOTE:**

Be sure not to spill any fuel when removing the fuel filter cup.

### Power unit

#### Checking the engine oil

1. Place the outboard motor in an upright position.
2. Remove the engine oil dipstick, wipe it clean, and then insert it back into the oil filler hole.
3. Remove the dipstick again to check the oil level, and the oil for discoloration and its viscosity.



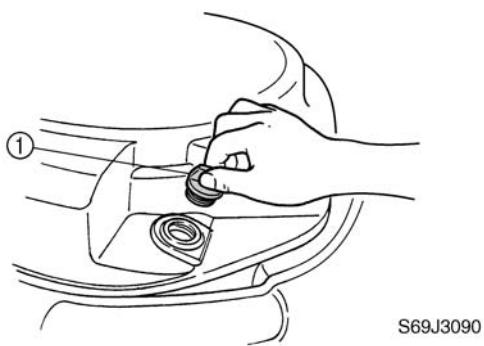
S69J3080

**NOTE:**

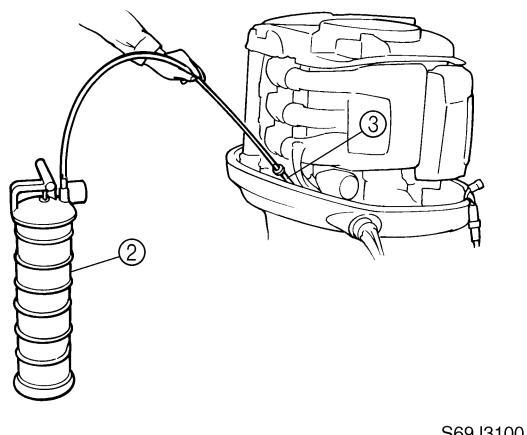
- Change the oil if it appears milky or dirty.
- If the engine oil is above the maximum level mark (H), drain sufficient oil until the level is between (H) and (L).
- If the engine oil is below the minimum level mark (L), add sufficient oil until the level is between (H) and (L).

### Changing the engine oil using an oil changer

1. Start the engine and warm it up.
2. Remove the engine oil dipstick and oil filler cap ①.



3. Insert the tube of the oil changer ② into the dipstick guide ③.



4. Operate the oil changer to extract the oil.

**NOTE:** \_\_\_\_\_  
Be sure to clean up any oil spills.

5. Pour the specified amount of the recommended engine oil into the oil filler hole.



Recommended engine oil:

4-stroke motor oil

API: SE, SF, SG, SH, or SJ

SAE: 10W-30 or 10W-40

Oil quantity:

Without oil filter replacement:

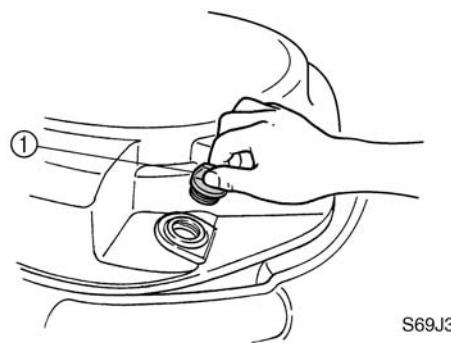
5.8 L (6.1 US qt, 5.1 Imp qt)

6. Install the oil filler cap and dipstick, and then start the engine and warm it up for 5 minutes.

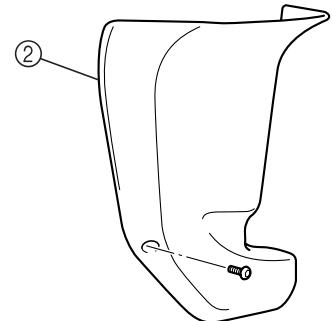
7. Turn the engine off, and then check the oil level and correct it if necessary.

### Changing the engine oil by draining it

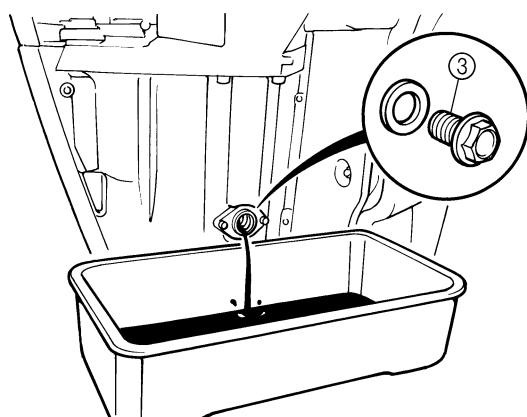
1. Start the engine and warm it up.
2. Remove the engine oil dipstick and oil filler cap ①.



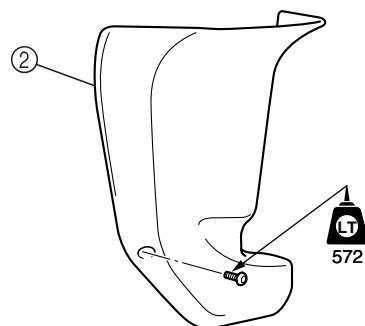
3. Remove the starboard apron ②.



4. Place a drain pan under the drain hole, and then remove the drain bolt ③ and let the oil drain completely.



S69J3130



S69J3140



Apron bolt:  
8 N·m (0.8 kgf·m, 5.8 ft·lb)

**NOTE:** \_\_\_\_\_  
Be sure to clean up any oil spills.

5. Install the drain bolt, and then tighten it to the specified torque.

 Drain bolt:  
27 N·m (2.7 kgf·m, 19 ft·lb)

6. Pour the specified amount of the recommended engine oil into the oil filler hole.

 Recommended engine oil:  
4-stroke motor oil  
API: SE, SF, SG, SH, or SJ  
SAE: 10W-30 or 10W-40  
Oil quantity:  
Without oil filter replacement:  
5.8 L (6.1 US qt, 5.1 Imp qt)

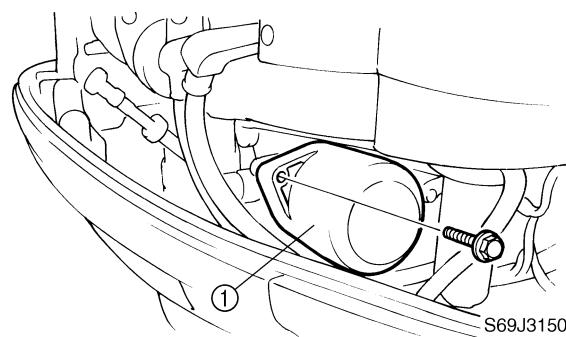
7. Install the oil filler cap and dipstick, and then start the engine and warm it up for 5 minutes.

8. Turn the engine off, and then check the oil level and correct it if necessary.

9. Install the starboard apron (2), and then tighten it to the specified torque.

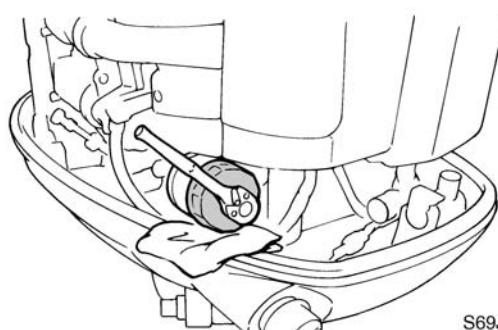
### Replacing the oil filter

1. Extract the engine oil with an oil changer or drain it.
2. Remove the oil filter cover (1).



S69J3150

3. Place a rag under the oil filter, and then remove the filter using a 72.5 mm (2.9 in) oil filter wrench.

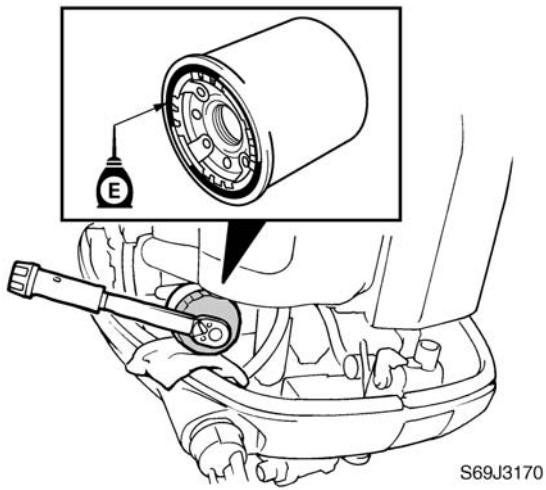


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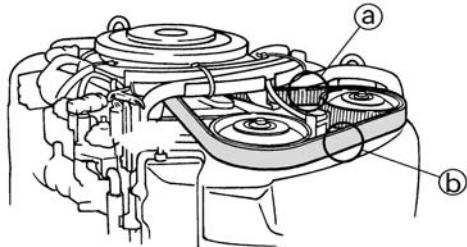
**NOTE:** \_\_\_\_\_  
Be sure to clean up any oil spills.

4. Apply a thin coat of engine oil to the O-ring of the new oil filter.

- Install the oil filter, and then tighten it to the specified torque using a 72.5 mm (2.9 in) oil filter wrench.



- Turn the crankshaft clockwise two turns to take up slack in the timing belt.



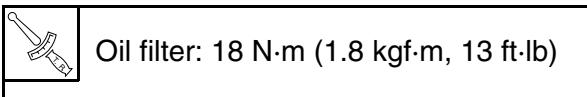
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**3**

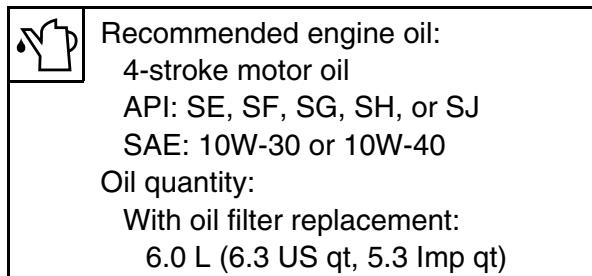
### Replacing the timing belt

**NOTE:**

For replacement procedures, see Chapter 5, "Replacing the timing belt."



- Pour the specified amount of the recommended engine oil into the oil filler hole.



- Install the oil filler cap and dipstick, and then start the engine and warm it up for 5 minutes.
- Turn the engine off, and then check the oil level and correct it if necessary.
- Install the oil filter cover.

### Checking the timing belt

- Remove the flywheel magnet cover.
- While turning the flywheel magnet clockwise, check the interior **a** and the exterior **b** of the timing belt for cracks, damage, or wear. Replace if necessary.

### Checking the valve clearance

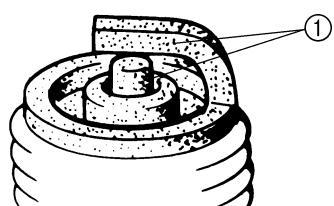
**NOTE:**

For checking procedures, see Chapter 5, "Checking the valve clearance."

### Checking the spark plugs

- Remove the ignition coil cover.

- Disconnect the spark plug wires, and then remove the spark plugs.
- Clean the electrodes **①** with a spark plug cleaner or wire brush. Replace the spark plug if necessary.



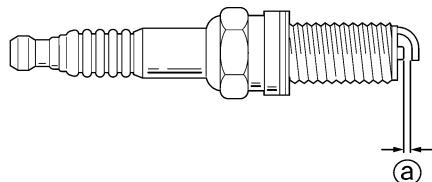
S69J3190

- Check the electrodes for erosion and excessive carbon or other deposits, and the gasket for damage. Replace the spark plug if necessary.

**CHK**  
**ADJ**

## Periodic checks and adjustments

- Check the spark plug gap ①. Adjust if out of specification.



S69J3200

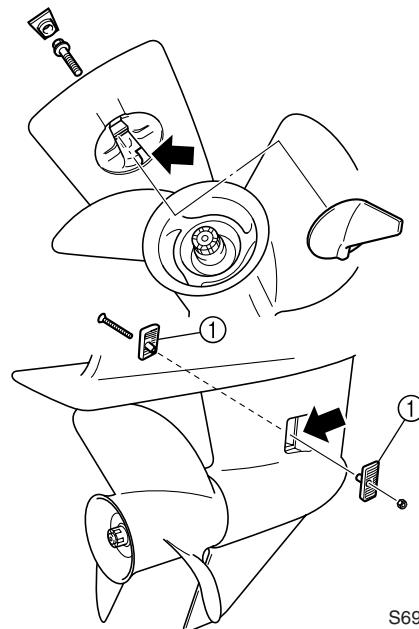


Specified spark plug:

LFR5A-11 (NGK)

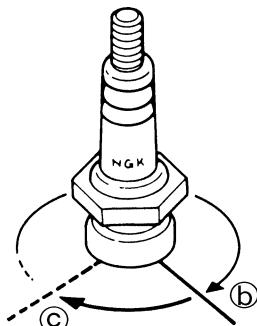
Spark plug gap ①:

1.0–1.1 mm (0.039–0.043 in)



S69J3220

- Install the spark plug, tighten it finger tight ②, then to the specified torque with a spark plug wrench ③.



S69J3210



Spark plug:

25 N·m (2.5 kgf·m, 18 ft·lb)

### Checking the thermostat

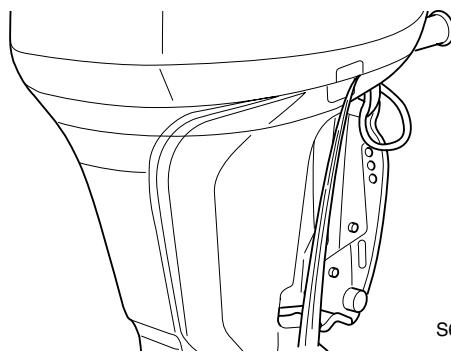
#### NOTE:

For checking procedures, see Chapter 5, "Checking the thermostat."

### Checking the cooling water passage

- Check the cooling water inlet cover ① and cooling water inlet for clogs. Clean if necessary.

- Place the lower unit in water, and then start the engine.
- Check for water flow at the cooling water pilot hole. If there is no water flow, check the cooling water passage inside the outboard motor.

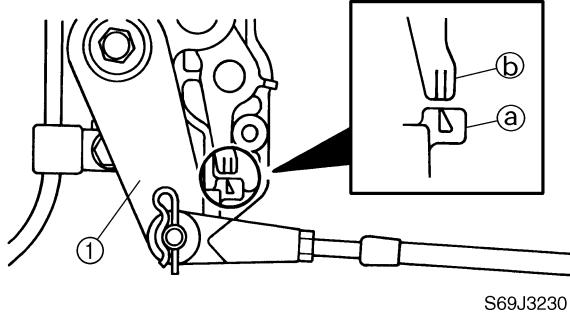


S69J3225

### Control system

#### Checking the throttle link and throttle cable operation

- Check that the throttle control cam ① is in its fully closed position and the alignment mark ② is between the alignment mark ③ when the remote control lever is in the neutral position. Adjust the length of the throttle cable and position of the throttle control lever if necessary.

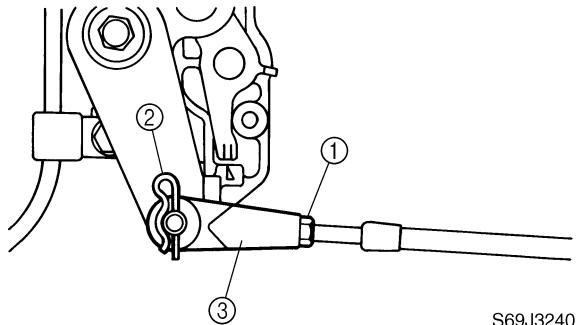


### Adjusting the throttle link and throttle cable operation (with a stop bolt)

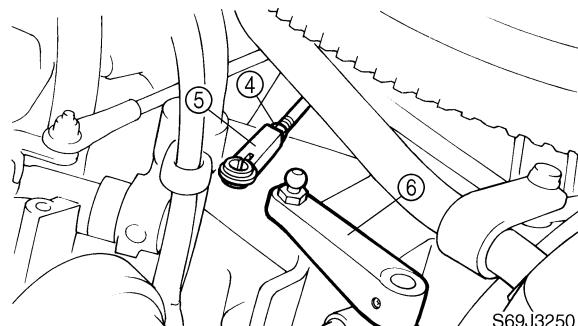
**NOTE:**

- Be sure to synchronize the throttle valves before adjusting the throttle link.
- For synchronizing procedures, see Chapter 4, "Synchronizing the throttle valve."

1. Loosen the locknut ①, remove the clip ②, and then disconnect the throttle cable joint ③.

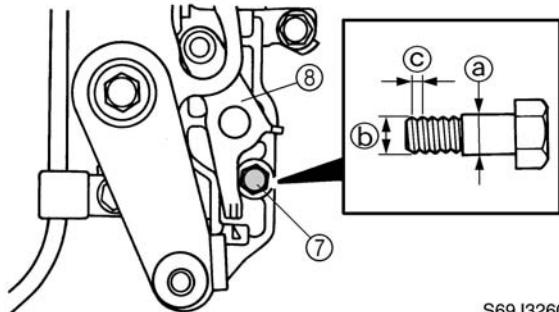


2. Loosen the locknut ④ and disconnect the link rod ⑤ from the magnet control lever ⑥.



3. Install the stop bolt (general bolt) ⑦ into the threaded hole.

4. Push the throttle control lever ⑧ against the stop bolt ⑦.



**NOTE:**

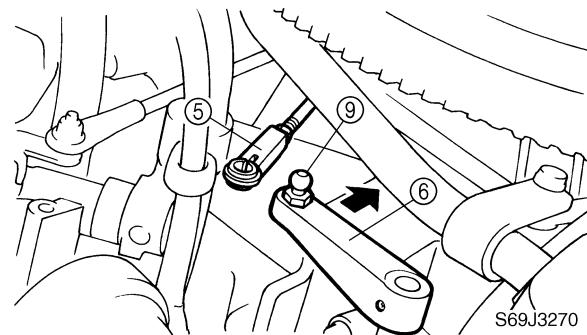
Use a general bolt with the specified measurements.



**Stop bolt ⑦:**

- ⓐ: 10 mm (0.39 in)
- ⓑ: 6.0 mm (0.24 in)
- ⓒ: 1.0 mm (0.04 in)

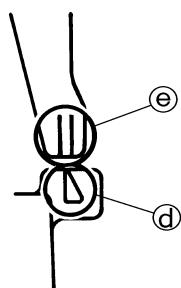
5. Push the magnet control lever ⑥ in the direction of the arrow to eliminate any looseness, and then adjust the link rod ⑤ so that it aligns with the magnet control lever joint ⑨.



6. Install the link rod ⑤ and tighten the locknut ④.
7. Remove the stop bolt ⑦.
8. Check that the alignment mark Ⓢ is between the alignment mark Ⓣ. If not, repeat steps 2–6.

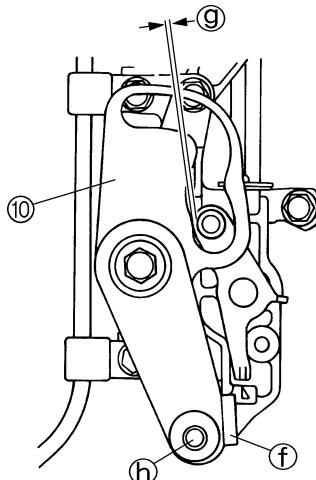
**CHK  
ADJ**

## Periodic checks and adjustments



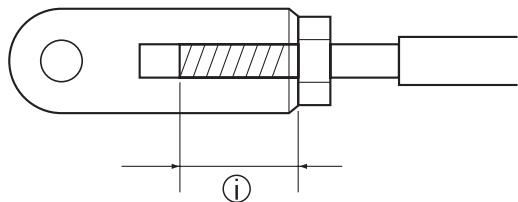
S69J3280

9. Place the throttle cam ⑩ against the fully closed stopper ⑫, and check that there is a minimum clearance ⑨ of approximately 1.0 mm (0.04 in).



S69J3290

10. Adjust the position of the throttle cable joint until its hole is aligned with the set pin ⑪ on the throttle cam.



S69J3300

**CAUTION:**

The throttle cable joint must be screwed in a minimum of 8.0 mm (0.31 in) ⑪.

11. Connect the cable joint, install the clip, and then tighten the locknut.

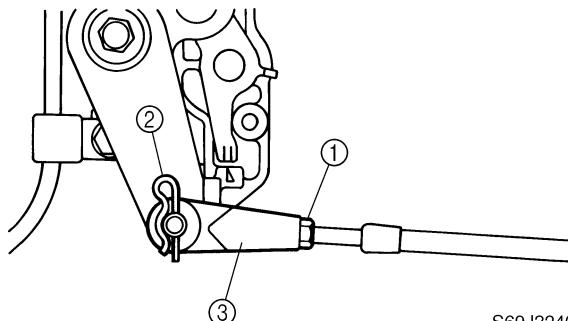
12. Check the throttle cable for smooth operation and adjust the cable length, if necessary, repeating steps 1–10.

### Adjusting the throttle link and throttle cable operation (without a stop bolt)

**NOTE:**

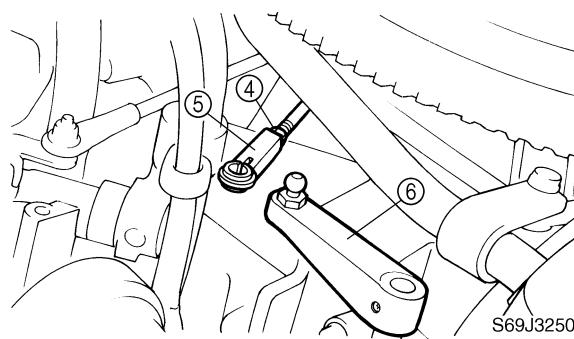
- Be sure to synchronize the throttle valves before adjusting the throttle link.
- For synchronizing procedures, see Chapter 4, "Synchronizing the throttle valve."

1. Loosen the locknut ①, remove the clip ②, and then disconnect the throttle cable joint ③.



S69J3240

2. Loosen the locknut ④ and disconnect the link rod ⑤ from the magnet control lever ⑥.

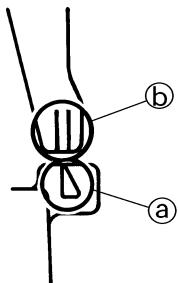


S69J3250

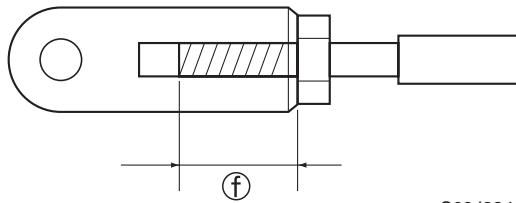
3. Adjust the link rod ⑤ so that the alignment mark ⑦ is between the alignment marks ⑧. Then, push the magnet control lever ⑥ in the direction of the arrow to eliminate any looseness.

4. Install the link rod ⑤ and tighten the locknut ④.

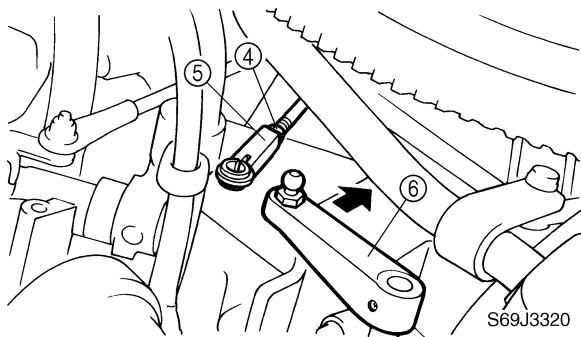
5. Check that the alignment mark **(a)** is between the alignment marks **(b)**. If not, repeat steps 2–4.



S69J3310

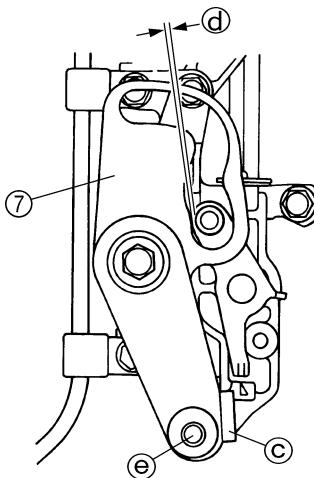


S69J3340



S69J3320

6. Place the throttle cam **(7)** against the fully closed stopper **(c)**, and check that there is a minimum clearance **(d)** of approximately 1.0 mm (0.04 in).



S69J3330

7. Adjust the position of the throttle cable joint until its hole is aligned with the set pin **(e)** on the throttle cam.

### CAUTION:

**The throttle cable joint must be screwed in a minimum of 8.0 mm (0.31 in) **(f)**.**

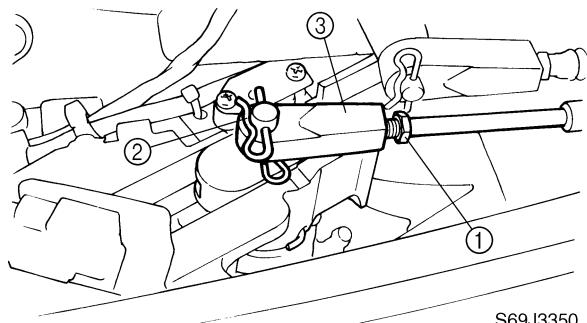
8. Connect the cable joint, install the clip, and then tighten the locknut.
9. Check the throttle cable for smooth operation and adjust the cable length, if necessary, repeating steps 1–7.

3

### Checking the gearshift operation

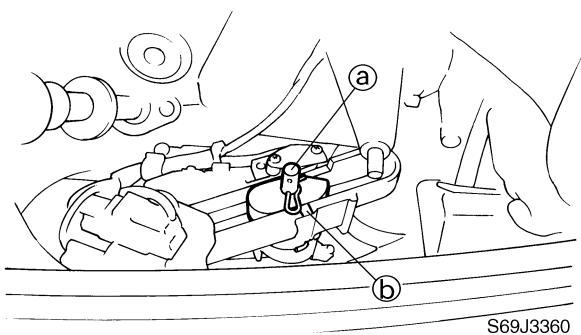
1. Check that the gearshift operates smoothly when shifting from neutral into forward or reverse. Adjust the shift cable length if necessary.

2. Set the gearshift to the neutral position.
3. Loosen the locknut **(1)**, remove the clip **(2)**, and then disconnect the shift cable joint **(3)**.



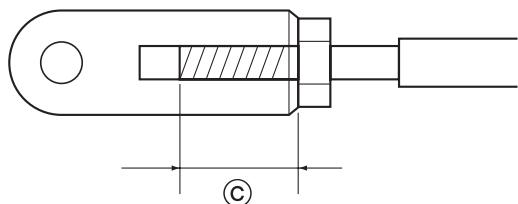
S69J3350

4. Align the set pin **(a)** in the center of the shift bracket and with the alignment marks **(b)** on the bracket.



S69J3360

5. Adjust the position of the shift cable joint until its hole is aligned with the set pin.



S69J3370

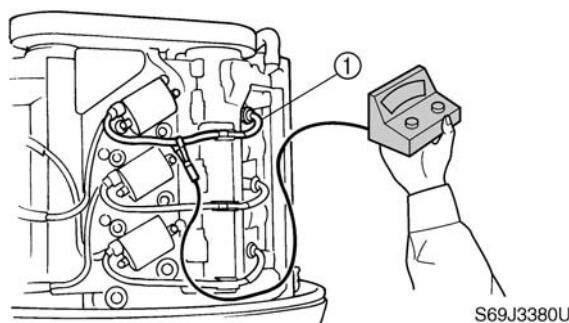
**CAUTION:**

**The shift cable joint must be screwed in a minimum of 8.0 mm (0.31 in) (C).**

6. Connect the cable joint, install the clip, and then tighten the locknut.
7. Check the gearshift for smooth operation and adjust the shift cable length, if necessary, repeating steps 3–6.

**Checking the engine idle speed**

1. Remove the ignition coil cover.
2. Start the engine and warm it up for 5 minutes.
3. Attach the special service tool to spark plug wire #1 ①, and then check the engine idle speed. Adjust if out of specification.



S69J3380U

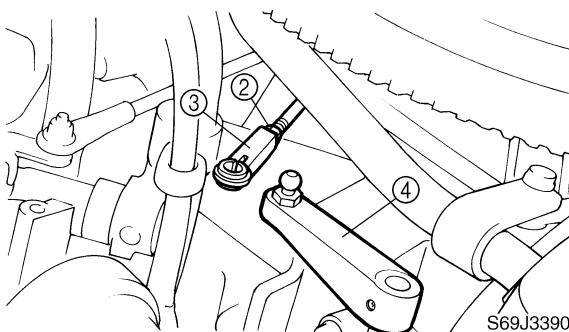


**Inductive self-powered tachometer:  
YU-08036-B**



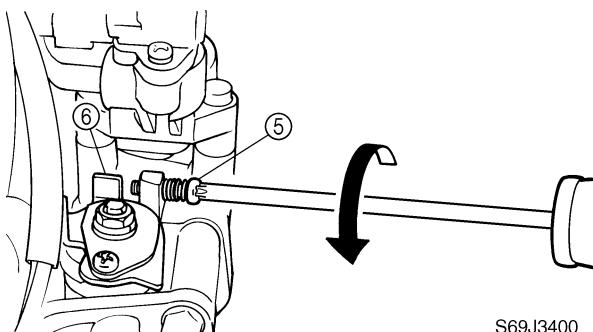
**Engine idle speed: 650–750 r/min**

4. Turn the engine off, loosen the locknut ②, and then disconnect the link rod ③ from the magnet control lever ④.



S69J3390

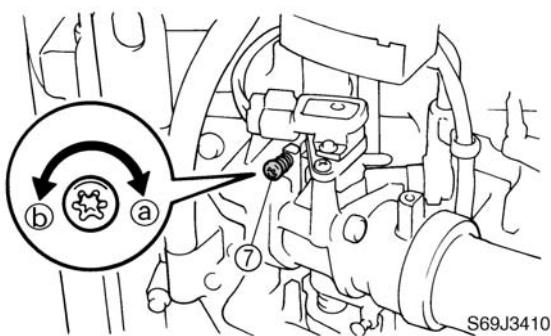
5. Loosen the port throttle stop screw ⑤ until it separates from the throttle body lever ⑥.



S69J3400

6. Start the engine, and then turn the starboard throttle stop screw ⑦ in direction ⑧ or ⑨ until the specified engine idle speed is obtained.

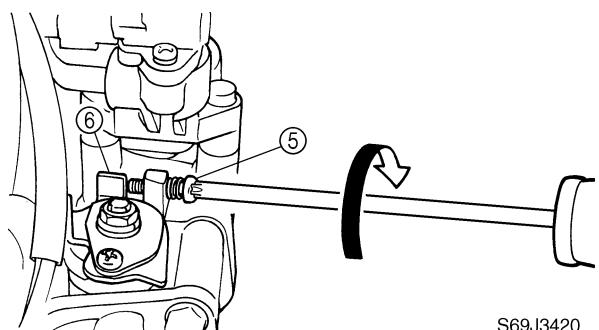
## Control system



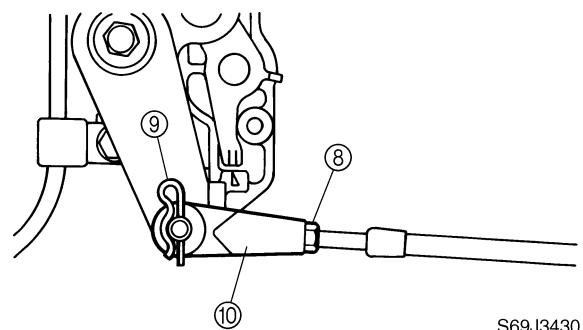
**NOTE:**

- To increase the idle speed, turn the throttle stop screw in direction ①.
- To decrease the idle speed, turn the throttle stop screw in direction ②.

7. Tighten the port throttle stop screw ⑤ until it contacts the throttle body lever ⑥.



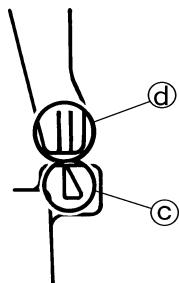
8. Loosen the locknut ⑧, remove the clip ⑨, and then disconnect the throttle cable joint ⑩.



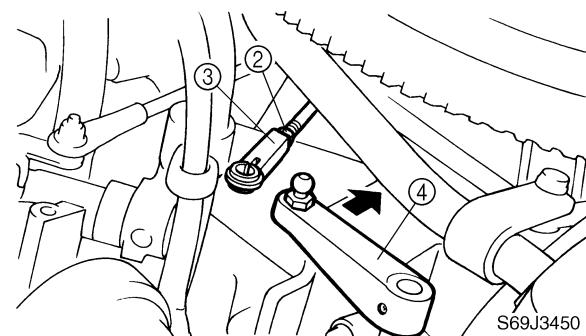
9. Adjust the link rod ③ so that the alignment mark ⑪ is between the alignment marks ⑫. Then, push the magnet control lever ⑭ in the direction of the arrow to eliminate any looseness.

10. Install the link rod ③, and then tighten the locknut ②.

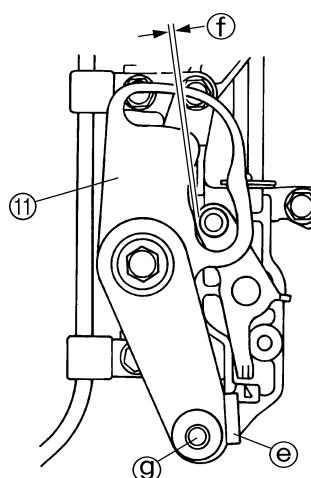
11. Check that the alignment mark ⑪ is between the alignment marks ⑫. If necessary, repeat steps 8–10.



3



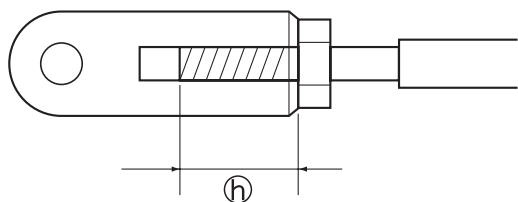
12. Place the throttle cam ⑪ against the fully closed stopper ⑬, and check that there is a minimum clearance ⑭ of approximately 1.0 mm (0.04 in).



13. Adjust the position of the throttle cable joint until its hole is aligned with the set pin ⑯ on the throttle cam.

**CHK  
ADJ**

## Periodic checks and adjustments



S69J3470

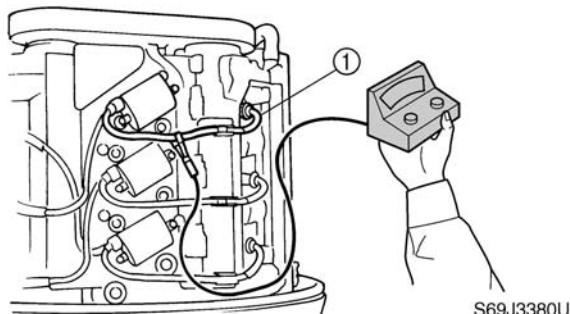
**CAUTION:**

The throttle cable joint must be screwed in a minimum of 8.0 mm (0.31 in)  $\textcircled{h}$ .

14. Connect the cable joint, install the clip, and then tighten the locknut.
15. Check the throttle cable for smooth operation and adjust the cable length, if necessary, repeating steps 8–12.

### Checking the ignition timing

1. Remove the ignition coil cover.
2. Start the engine and warm it up for 5 minutes.
3. Attach the special service tool to spark plug wire #1  $\textcircled{1}$ , and then check the engine idle speed. Adjust if out of specification.



S69J3380U

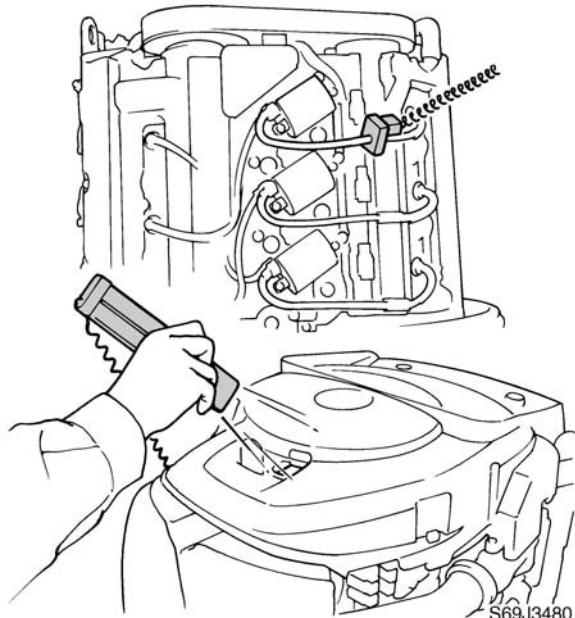


Inductive self-powered tachometer:  
YU-08036-B



Engine idle speed: 650–750 r/min

4. Attach the special service tool to spark plug wire #1.

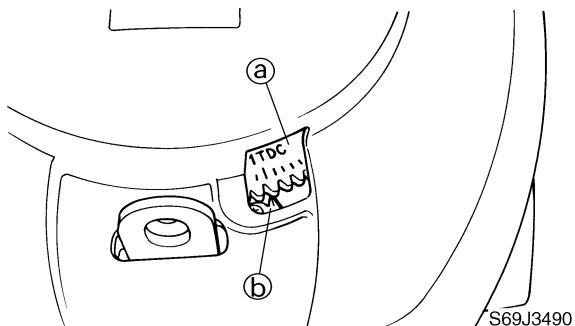


S69J3480



Battery powered timing light:  
YM-33277-A

5. Check that the “1TDC” mark  $\textcircled{a}$  on the flywheel magnet is aligned with the magnet base pointer  $\textcircled{b}$ .

 $\textcircled{a}$  $\textcircled{b}$ 

S69J3490



Ignition timing: TDC

### Power trim and tilt unit

#### Checking the power trim and tilt operation

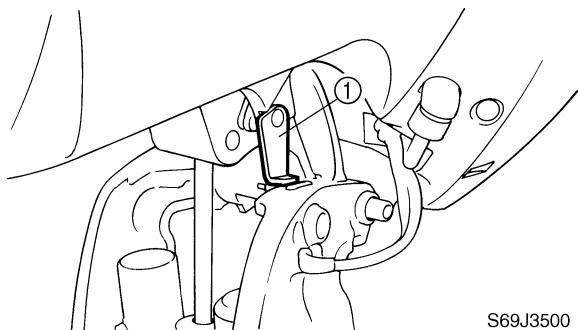
1. Fully tilt the outboard motor up and down a few times and check the entire trim and tilt range for smooth operation. Check the power trim and tilt fluid level if necessary.

## Control system / Power trim and tilt unit / Lower unit

### NOTE:

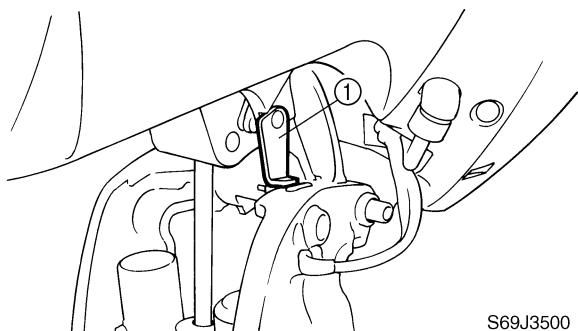
Be sure to listen to the winding sound of the power trim and tilt motor for smooth operation.

- Fully tilt the outboard motor up, and then support it with the tilt stop lever ① to check the lock mechanism of the lever.



### Checking the power trim and tilt fluid level

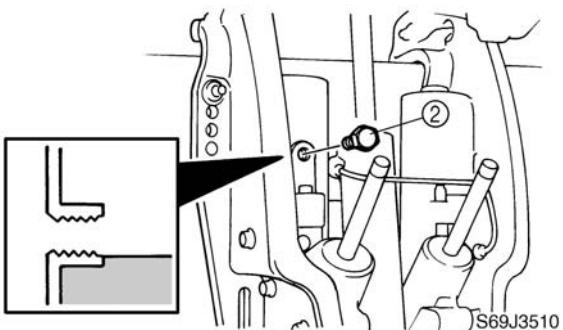
- Fully tilt the outboard motor up, and then support it with the tilt stop lever ①.



### **WARNING**

After tilting up the outboard motor, be sure to support it with the tilt stop lever. Otherwise, the outboard motor could suddenly lower if the power trim and tilt unit should lose fluid pressure.

- Remove the reservoir cap ②, and then check the fluid level in the reservoir.



### NOTE:

If the fluid is at the correct level, the fluid should overflow out of the filler hole when the cap is removed.

- If necessary, add sufficient fluid of the recommended type until it overflows out of the filler hole.



Recommended power trim and tilt fluid:

ATF Dexron II

- Install the reservoir cap, and then tighten it to the specified torque.



Reservoir cap:

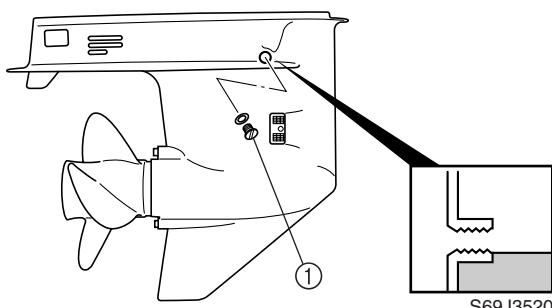
7 N·m (0.7 kgf·m, 5.1 ft·lb)

### Lower unit

#### Checking the gear oil level

- Fully tilt the outboard motor down.

- Remove the check screw ①, and then check the gear oil level in the lower case.



**CHK**  
**ADJ**

## Periodic checks and adjustments

**NOTE:**

If the oil is at the correct level, the oil should overflow out of the check hole when the check screw is removed.

3. If necessary, add sufficient gear oil of the recommended type until it overflows out of the check hole.

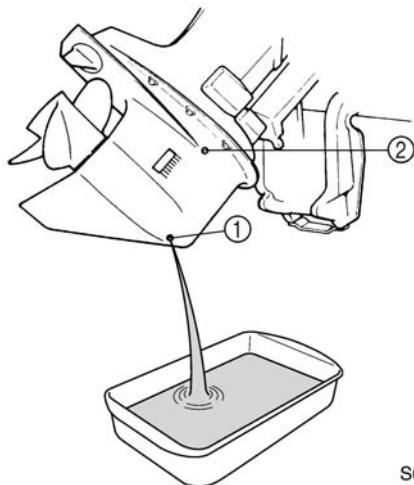


Recommended gear oil:  
GEAR CASE LUBE  
Hypoid gear oil  
SAE: 90

4. Install the check screw.

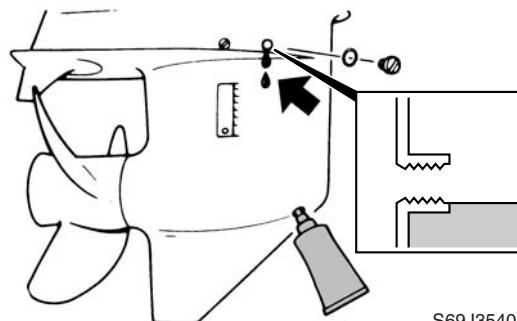
### Changing the gear oil

1. Tilt the outboard motor up slightly.
2. Place a drain pan under the drain screw ①, remove the drain screw, then the check screw ② to drain the oil.

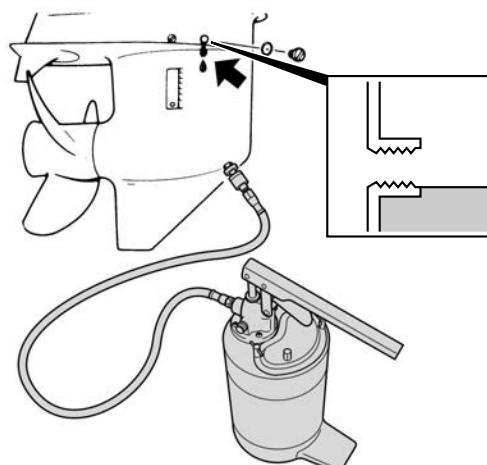


S69J3530

3. Check the oil for metal, discoloration, and its viscosity. Check the internal parts of the lower case if necessary.
4. Insert the gear oil tube or gear oil pump into the drain hole and slowly fill the gear oil until oil flows out of the check hole and no air bubbles are visible.



S69J3540



S69J3550



Recommended gear oil:  
GEAR CASE LUBE  
Hypoid gear oil  
SAE: 90

Oil quantity:

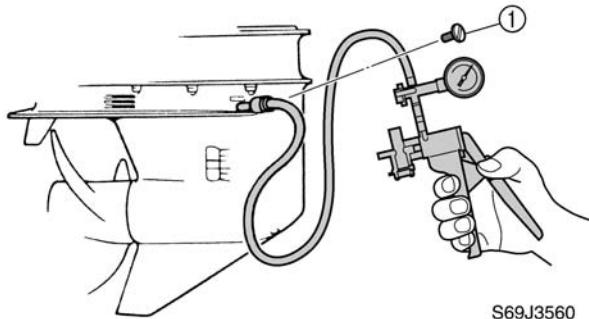
Regular rotation model:  
1.15 L (1.22 US qt, 1.01 Imp qt)

Counter rotation model:  
1.00 L (1.06 US qt, 0.88 Imp qt)

5. Install the check screw and quickly install the drain screw.

### Checking the lower unit (for air leakage)

1. Remove the check screw ①, and then install the special service tool.



Pressure/vacuum tester:  
YB-35956-A

2. Apply the specified pressure to check whether the lower unit can hold it for at least 10 seconds.

**CAUTION:**

**Do not over pressurize the lower unit, otherwise the oil seals may be damaged.**

**NOTE:**

Cover the check hole with a rag when removing the pressure/vacuum tester from the lower unit.

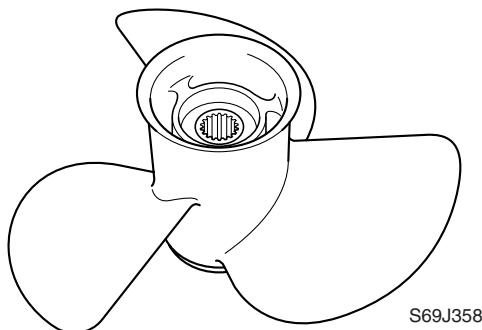


Lower unit holding pressure:  
70 kPa (0.7 kgf/cm<sup>2</sup>, 10 psi)

3. If pressure drops below specification, check the drive shaft and propeller shaft oil seals for damage.

### Checking the propeller

1. Check the propeller blades and splines for cracks, damage, or wear. Replace if necessary.

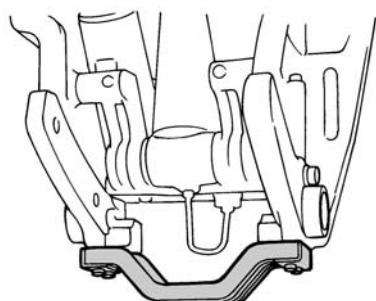
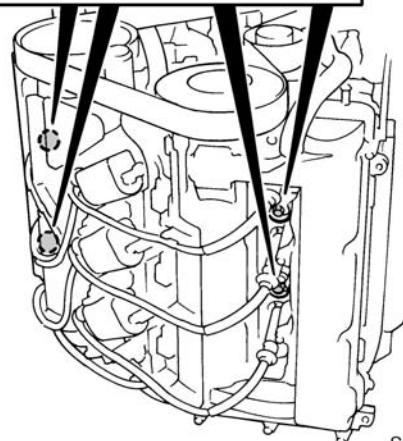
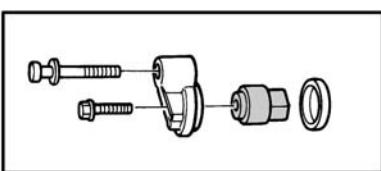


3

### General

#### Checking the anodes

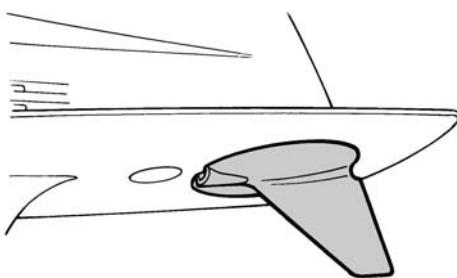
1. Check the anodes and trim tab for scales, grease, or oil. Clean if necessary.



S69J3600

**CHK  
ADJ**

## Periodic checks and adjustments



S69J3610

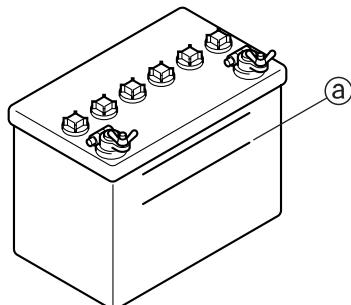
**CAUTION:**

**Do not oil, grease, or paint the anodes, otherwise they will be ineffective.**

2. Replace the anodes and trim tab if excessively eroded.

**Checking the battery**

1. Check the battery electrolyte level. If the level is at or below the minimum level mark (a), add distilled water until the level is between the maximum and minimum level marks.



S69J3620

2. Check the specific gravity of the electrolyte. Fully charge the battery if out of specification.

**WARNING**

Battery electrolyte is dangerous; it contains sulfuric acid which is poisonous and highly caustic.

Always follow these preventive measures:

- Avoid bodily contact with electrolyte as it can cause severe burns or permanent eye injury.
- Wear protective eye gear when handling or working near batteries.

**Antidote (EXTERNAL):**

- SKIN – Wash with water.
- EYES – Flush with water for 15 minutes and get immediate medical attention.

**Antidote (INTERNAL):**

- Drink large quantities of water or milk followed with milk of magnesia, beaten egg, or vegetable oil. Get immediate medical attention.

Batteries generate explosive, hydrogen gas. Always follow these preventive measures:

- Charge batteries in a well-ventilated area.
- Keep batteries away from fire, sparks or open flames (e.g., welding equipment, lighted cigarettes).
- DO NOT SMOKE when charging or handling batteries.

**KEEP BATTERIES AND ELECTROLYTE OUT OF REACH OF CHILDREN.**

**NOTE:**

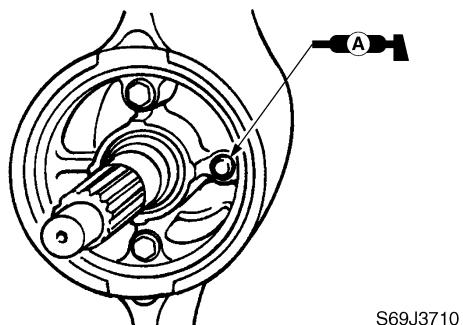
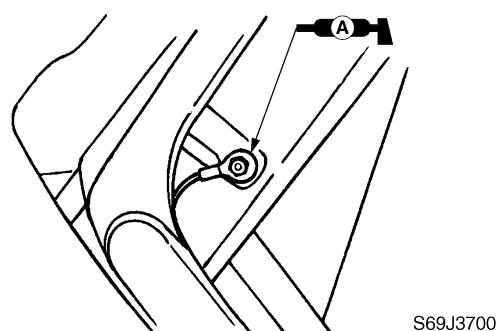
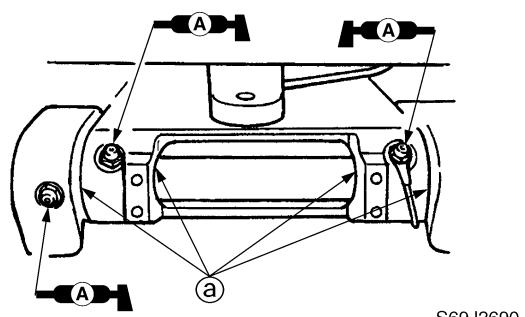
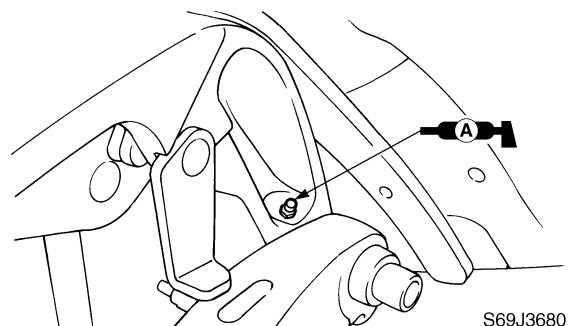
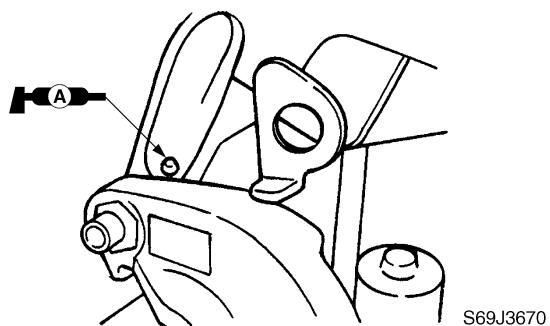
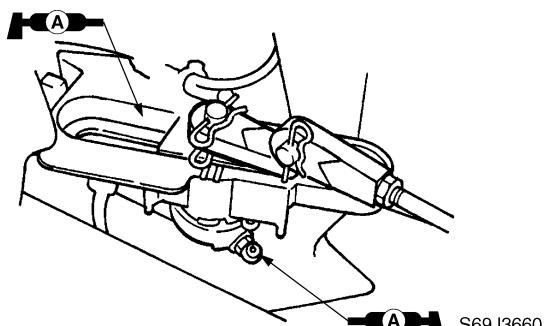
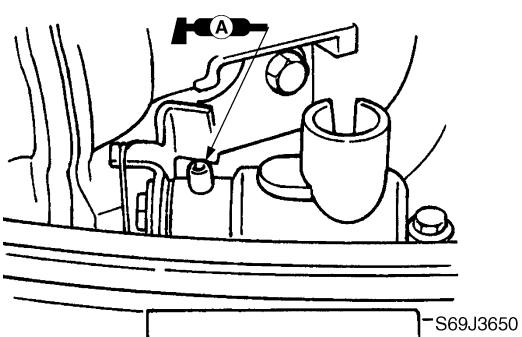
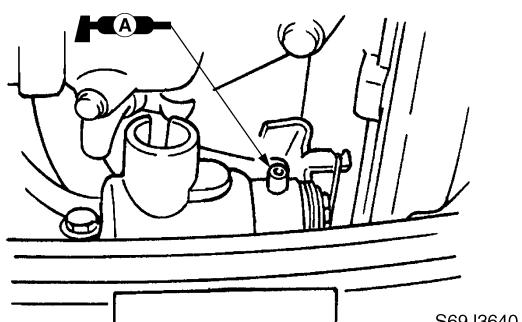
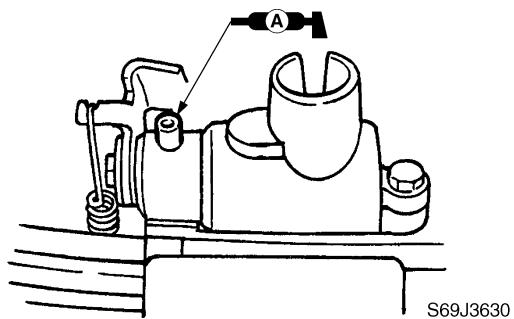
- Batteries vary per manufacturer. The procedures mentioned in this manual may not always apply, therefore, consult the instruction manual of the battery.
- Disconnect the black battery cable first, then the red battery cable.



Electrolyte specific gravity:  
1.280 at 20 °C (68 °F)

**Lubrication**

1. Apply water resistant grease to the areas shown.



3

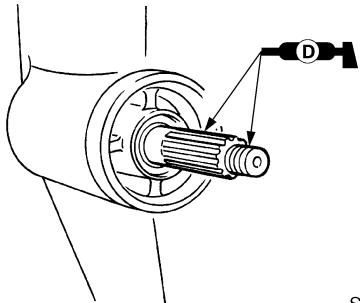
**CHK**  
**ADJ**



## Periodic checks and adjustments

**NOTE:** \_\_\_\_\_  
Apply grease to the grease nipple until it flows from the bushings **a**.  
\_\_\_\_\_

2. Apply corrosion resistant grease to the areas shown.



S69J3720



## Fuel system

<b>Special service tools .....</b>	<b>4-1</b>
<b>Hose routing .....</b>	<b>4-2</b>
Fuel and blowby hoses.....	4-2
<b>Intake silencer, fuel filter, and fuel pump .....</b>	<b>4-3</b>
<b>Vapor separator.....</b>	<b>4-5</b>
Removing the hose clamps .....	4-7
Installing the hose clamps .....	4-7
Checking the check valve.....	4-7
Reducing the fuel pressure.....	4-7
Checking the vapor separator .....	4-8
<b>Intake manifold and high-pressure fuel line.....</b>	<b>4-9</b>
<b>Throttle control.....</b>	<b>4-13</b>
Removing the pressure regulator .....	4-15
Disconnecting the high-pressure fuel hose joint.....	4-15
Checking the fuel injector .....	4-15
Checking the idle speed control (ISC) .....	4-15
Synchronizing the throttle valve.....	4-16

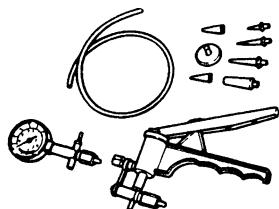
**FUEL**



**Fuel system**

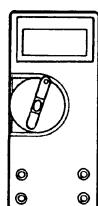
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## Special service tools



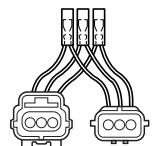
**Pressure/vacuum tester**

**YB-35956-A**



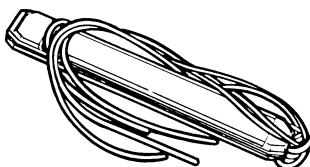
**Digital multimeter**

**YU-34899-A**



**Test harness (3 pins)**

**YB-06793**

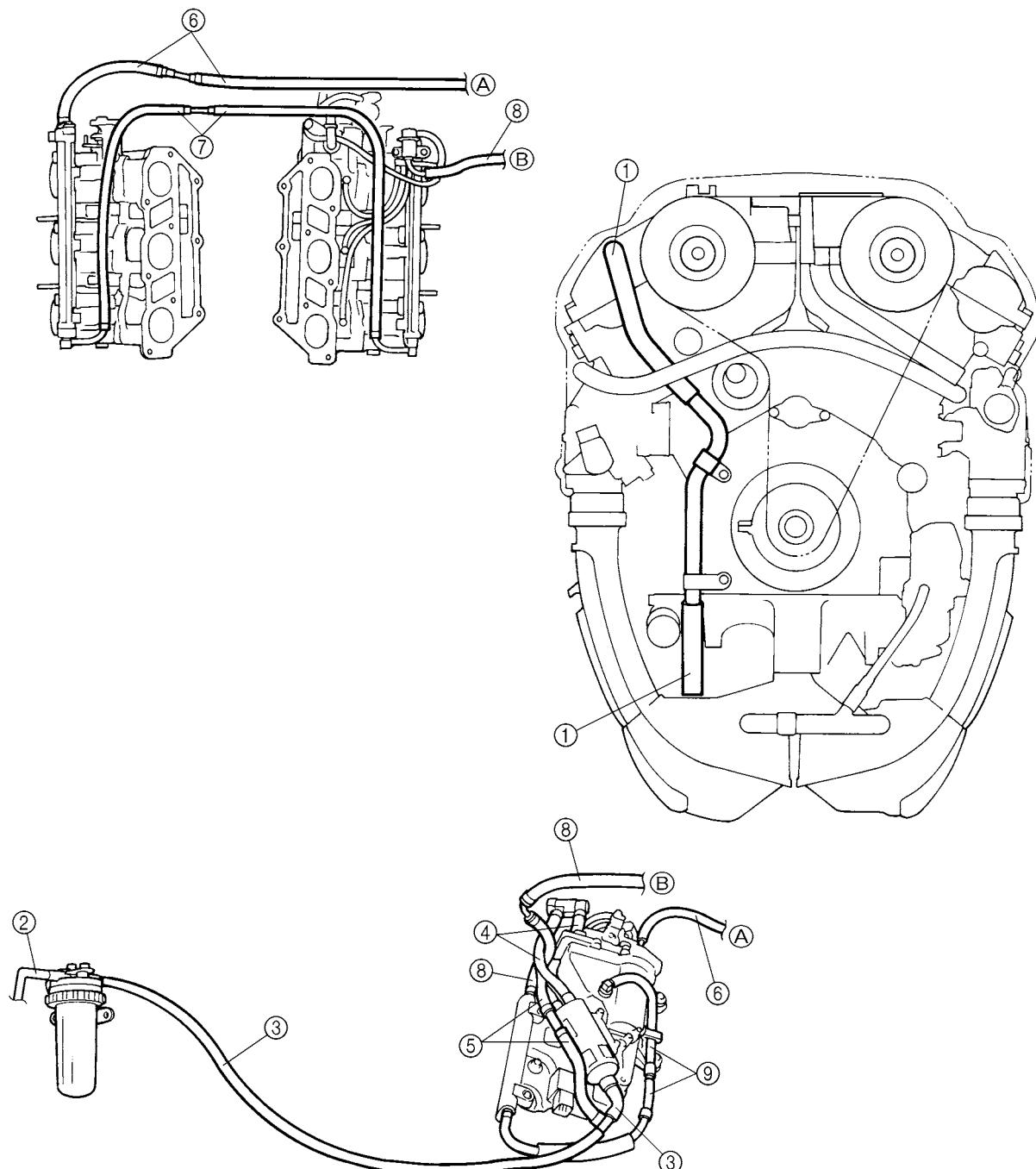


**Carburetor synchronizer**

**YU-08030**

## Hose routing

### Fuel and blowby hoses



S69J4010U

- ① Blowby hose
- ② Fuel hose (fuel joint-to-fuel filter)
- ③ Fuel hose (fuel filter-to-fuel pump)
- ④ Fuel hose (fuel pump-to-vapor separator)
- ⑤ Fuel hose (vapor separator-to-fuel pump)
- ⑥ High-pressure fuel hose  
(vapor separator-to-starboard fuel rail)

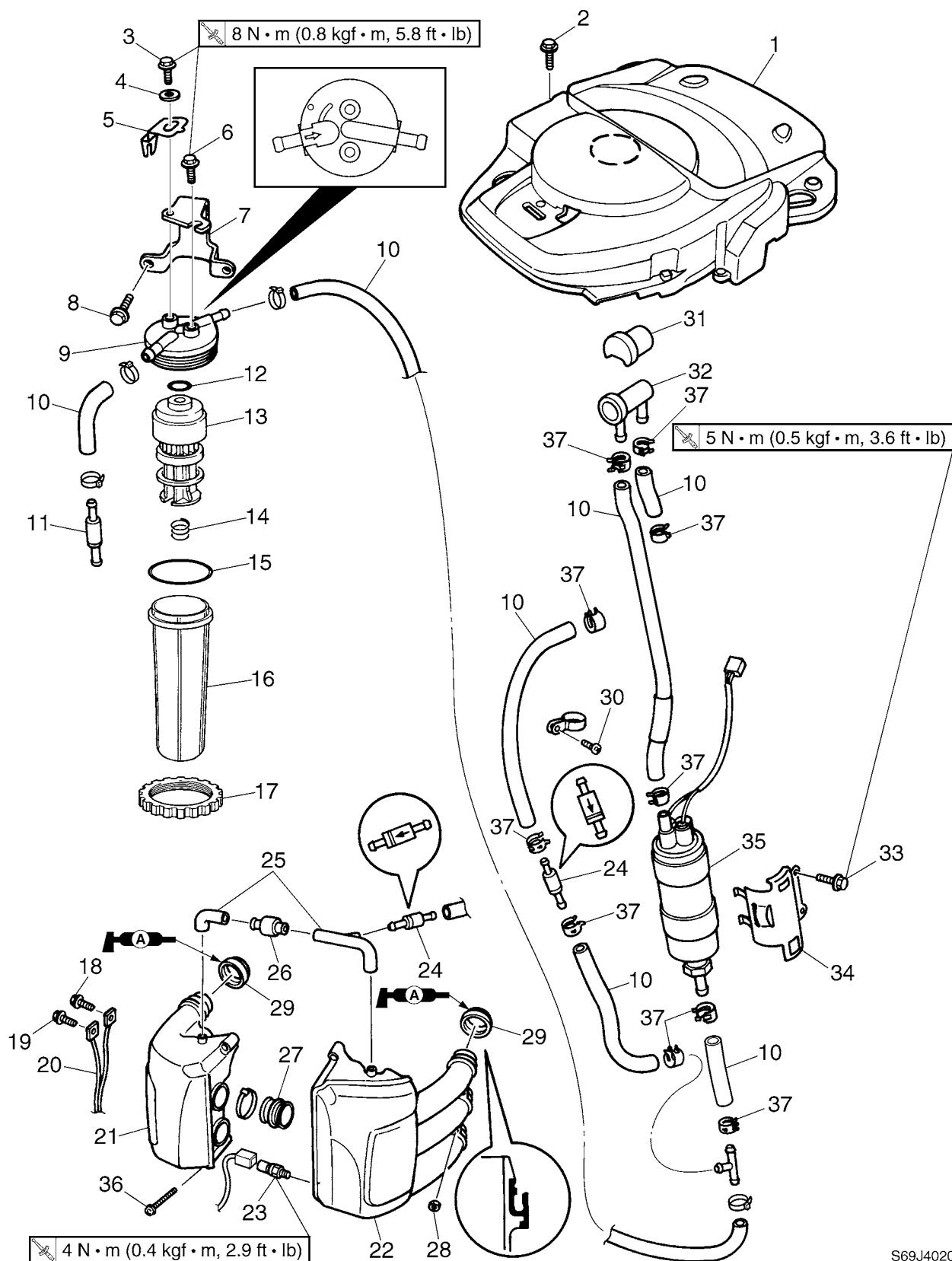
- ⑦ High-pressure fuel hose  
(starboard fuel rail-to-port fuel rail)
- ⑧ Fuel hose (pressure regulator-to-fuel cooler)
- ⑨ Fuel hose (fuel cooler-to-vapor separator)

## FUEL



## Fuel system

### Intake silencer, fuel filter, and fuel pump



S69J4020U

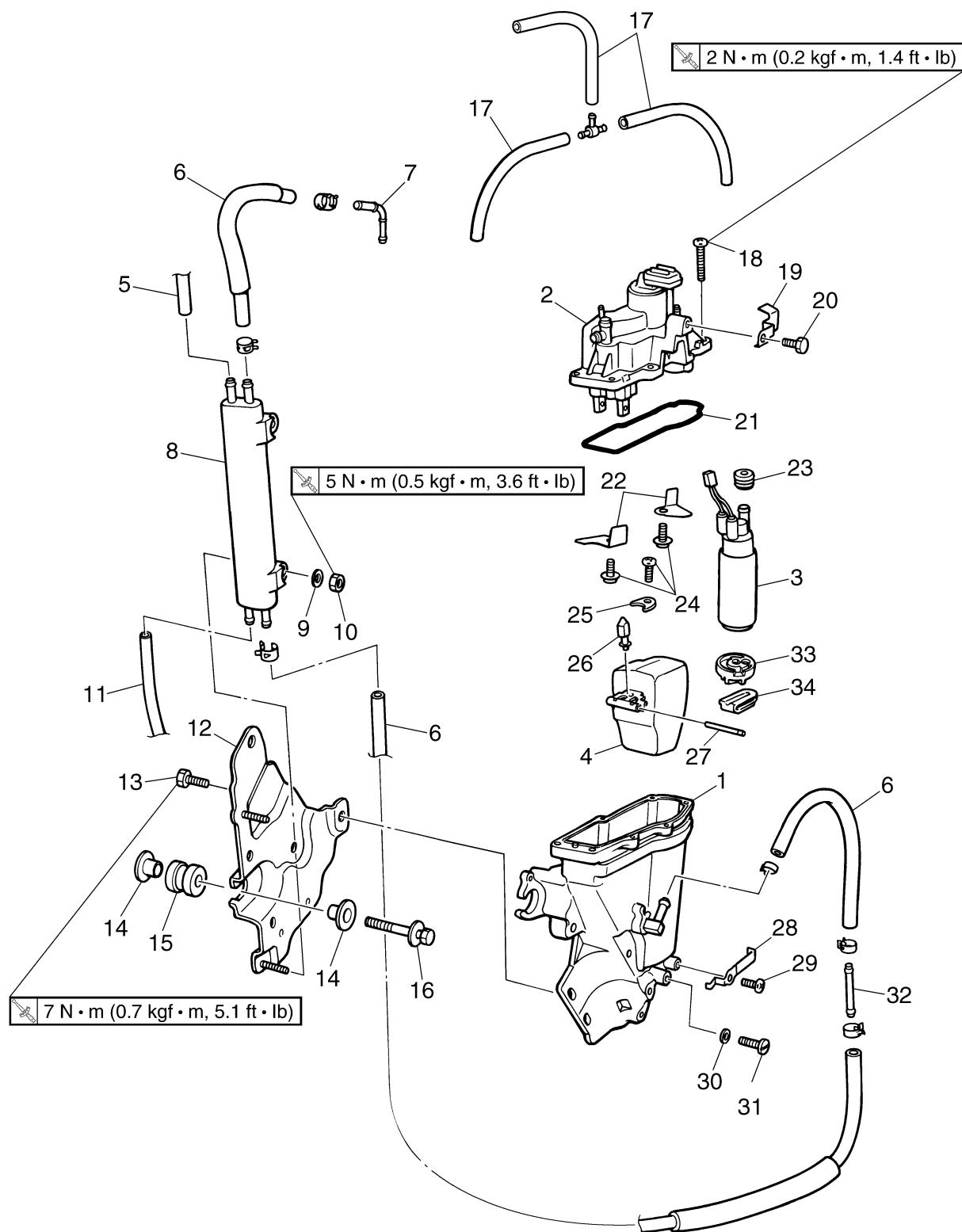
## Intake silencer, fuel filter, and fuel pump

No.	Part name	Q'ty	Remarks
1	Cover	1	
2	Bolt	3	M6 × 28 mm
3	Bolt	1	M6 × 16 mm
4	Washer	1	
5	Holder	1	
6	Bolt	1	M6 × 14 mm
7	Bracket	1	
8	Bolt	2	M6 × 19 mm
9	Cap	1	
10	Fuel hose	7	
11	Fuel joint	1	
12	O-ring	1	<b>Not reusable</b>
13	Fuel filter element	1	
14	Spring	1	
15	O-ring	1	<b>Not reusable</b>
16	Cup	1	
17	Nut	1	
18	Bolt	1	M6 × 16 mm
19	Bolt	1	M7 × 20 mm
20	Battery cable	1	
21	Starboard intake silencer	1	
22	Port intake silencer	1	
23	Intake air temperature sensor	1	
24	Check valve	2	
25	Hose	2	
26	Joint	1	
27	Joint	2	
28	Nut	4	
29	Grommet	6	
30	Screw	1	M5 × 7 mm
31	Cover	1	
32	Fuel filter	1	
33	Bolt	2	M5 × 12 mm
34	Bracket	1	
35	Low-pressure fuel pump	1	
36	Bolt	4	M6 × 45 mm
37	Clamp	10	

4



## Vapor separator



S69J4060U

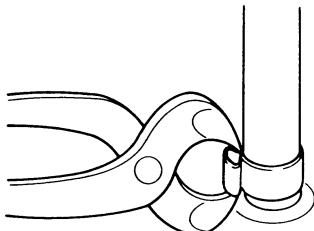
## Vapor separator

No.	Part name	Q'ty	Remarks
1	Float chamber	1	
2	Cover	1	
3	High-pressure fuel pump	1	
4	Float	1	
5	Water hose	1	
6	Fuel hose	3	
7	Joint	1	
8	Fuel cooler	1	
9	Washer	2	
10	Nut	2	
11	Water hose	1	
12	Bracket	1	
13	Bolt	3	M8 × 16 mm
14	Collar	6	
15	Bushing	4	
16	Bolt	4	M8 × 16 mm
17	Hose	3	
18	Screw	7	M4 × 15 mm
19	Bracket	1	
20	Bolt	1	M6 × 10 mm
21	Gasket	1	Not reusable
22	Plate	2	
23	Grommet	1	
24	Screw	3	M4 × 8 mm
25	Plate	1	
26	Needle valve	1	
27	Pin	1	
28	Bracket	1	
29	Screw	1	
30	Gasket	1	
31	Drain screw	1	
32	Joint	1	
33	Filter	1	
34	Filter holder	1	

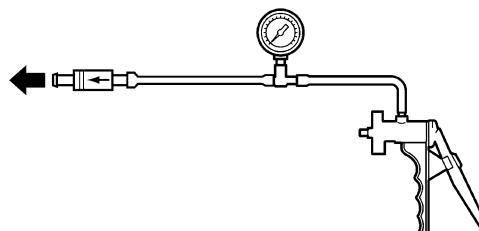
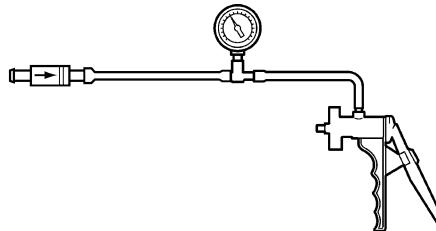
4

**FUEL****Fuel system****Removing the hose clamps**

1. Remove the hose clamps by cutting the joint.



S69J4030



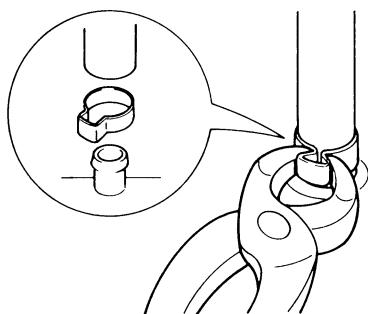
S69J4050

**CAUTION:**

If the hose clamps are removed without cutting the joint first, the fuel hose will be damaged.

**Installing the hose clamps**

1. Crimp the hose clamps properly to securely fasten them.



S69J4040

**⚠ WARNING**

Do not reuse the hose clamps, always replace them with new ones.

**Checking the check valve**

1. Install the special service tool onto the check valve.



Pressure/vacuum tester:  
YB-35956-A

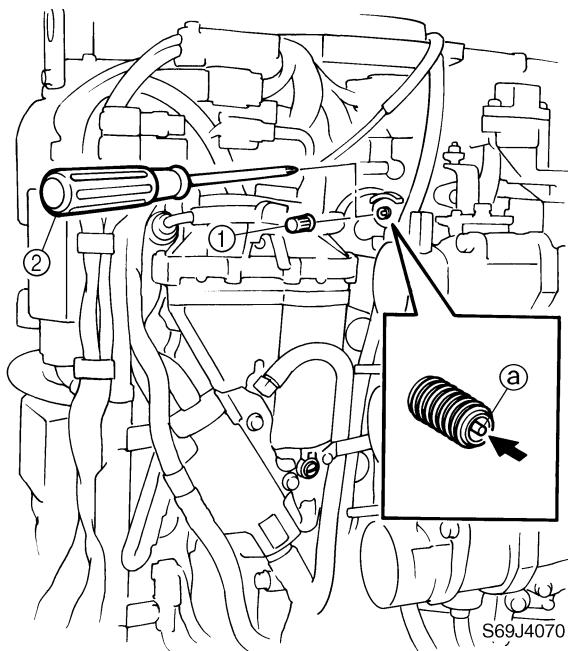
2. Apply the pressure to each check valve port. Replace if necessary.

**NOTE:**

Make sure no air comes out of the opposite side of the check valve.

**Reducing the fuel pressure**

1. Remove the cap ①.
2. Cover the pressure check valve ② of the vapor separator with a rag, and then press in the valve using a thin screwdriver ③ to release the fuel pressure.



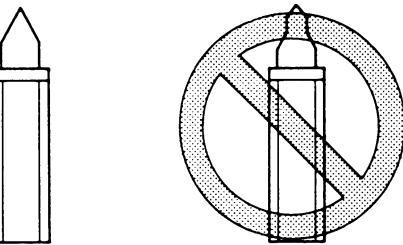
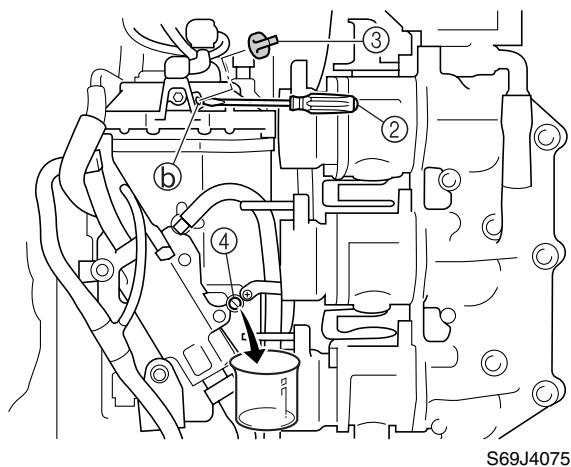
### ⚠️ WARNING

Reduce the fuel pressure before removing the vapor separator drain screw, or pressurized fuel will spray out and may result in serious injury.

### ⚠️ WARNING

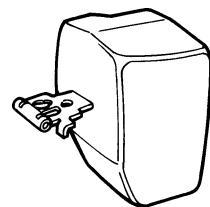
Always reduce the fuel pressure in the high-pressure fuel line before servicing the line or the vapor separator. If the fuel pressure is not released, pressurized fuel may spray out.

3. Remove the cap ③, and then press in the valve ⑥ using a thin screwdriver ②.
4. Place a container under the vapor separator, and then drain the fuel from the separator by removing the drain screw ④.



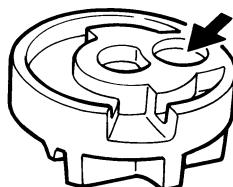
S69J4080

2. Check the float for deterioration. Replace if necessary.



S69J4090

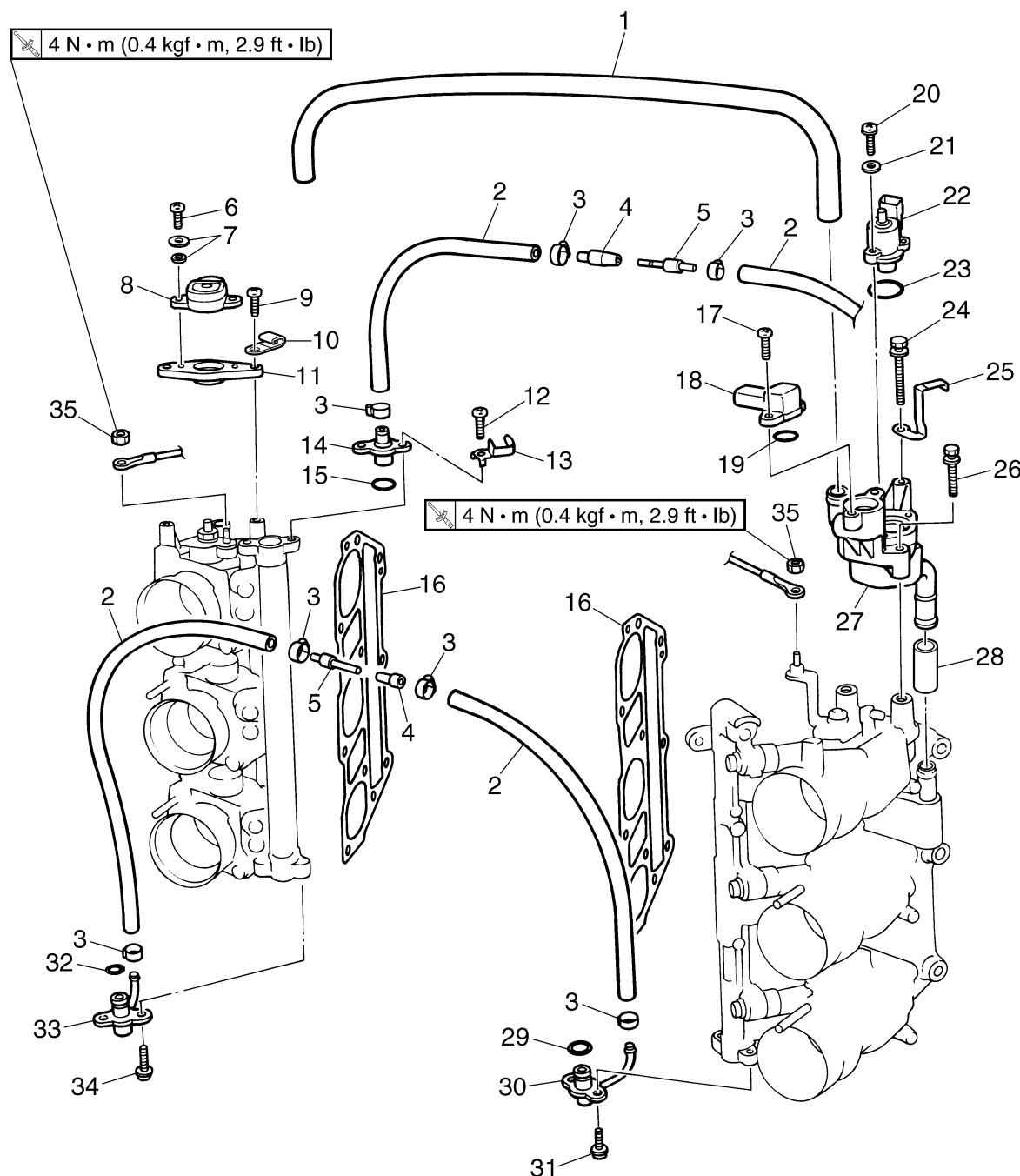
3. Check the filter for dirt or residue. Clean if necessary.



S69J4100



## Intake manifold and high-pressure fuel line

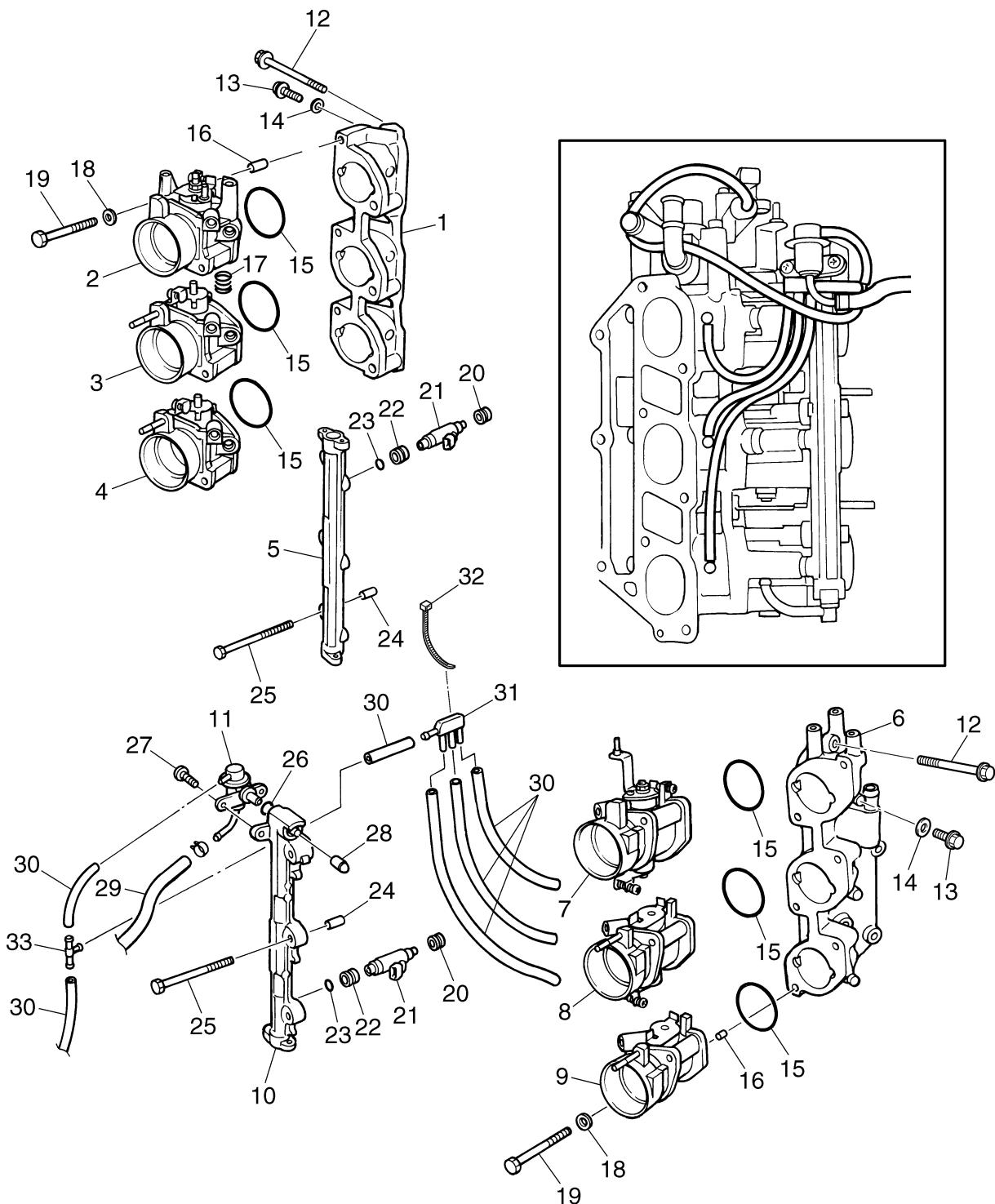


S69J4110

## Intake manifold and high-pressure fuel line

4

No.	Part name	Q'ty	Remarks
1	Hose	1	
2	High-pressure fuel hose	4	
3	Clamp	7	
4	Joint	2	
5	Joint	2	
6	Screw	2	
7	Washer	4	
8	Throttle position sensor	1	
9	Screw	2	
10	Bracket	1	
11	Bracket	1	
12	Screw	2	M5 × 15 mm
13	Bracket	1	
14	Joint	1	
15	O-ring	1	Not reusable
16	Metal gasket	2	Not reusable
17	Screw	2	M5 × 15 mm
18	Intake air pressure sensor	1	
19	O-ring	1	Not reusable
20	Screw	3	M4 × 16 mm
21	Washer	3	
22	Idle speed control	1	
23	O-ring	1	Not reusable
24	Bolt	1	M6 × 55 mm
25	Bracket	1	
26	Bolt	2	M6 × 30 mm
27	Body	1	
28	Hose	1	
29	O-ring	1	Not reusable
30	Joint	1	
31	Screw	2	M5 × 15 mm
32	O-ring	1	Not reusable
33	Joint	1	
34	Screw	2	M5 × 15 mm
35	Nut	2	



S69J4120

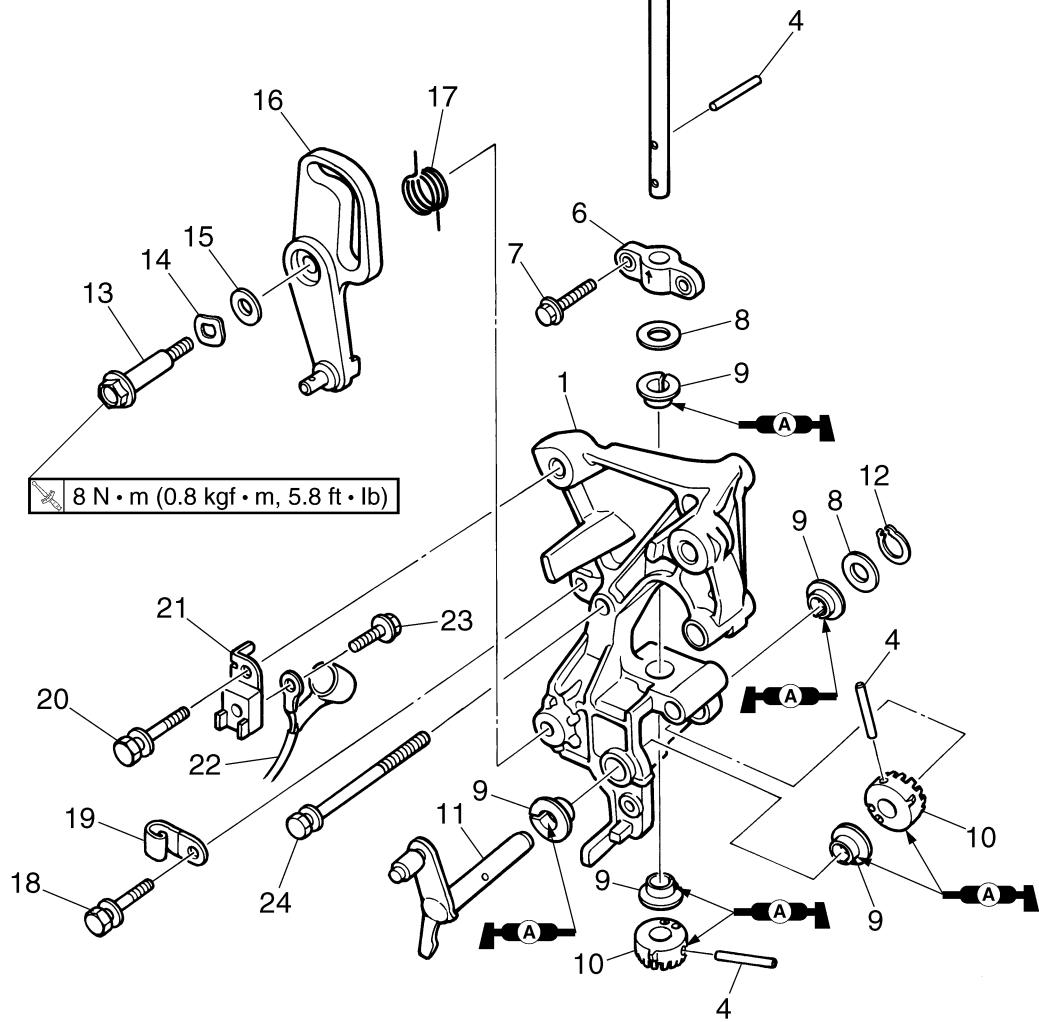
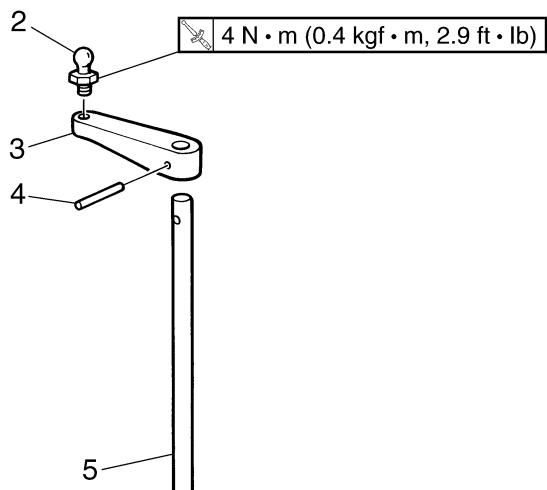
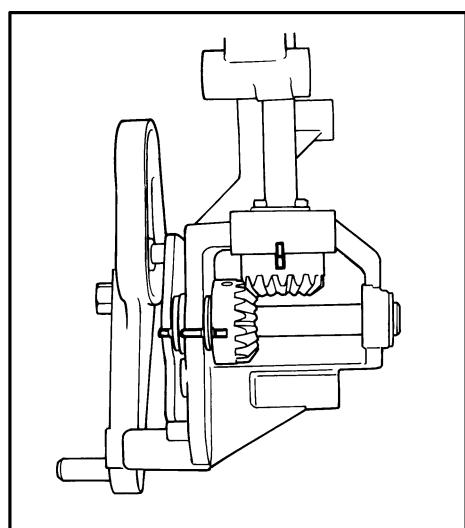
## Intake manifold and high-pressure fuel line

No.	Part name	Q'ty	Remarks
1	Starboard intake manifold	1	
2	Throttle body #1	1	
3	Throttle body #3	1	
4	Throttle body #5	1	
5	Starboard fuel rail	1	
6	Port intake manifold	1	
7	Throttle body #2	1	
8	Throttle body #4	1	
9	Throttle body #6	1	
10	Port fuel rail	1	
11	Pressure regulator	1	
12	Bolt	18	M8 × 35 mm
13	Bolt	6	M6 × 10 mm
14	Gasket	6	<b>Not reusable</b>
15	Gasket	6	<b>Not reusable</b>
16	Collar	12	
17	Spring	1	
18	Washer	12	
19	Bolt	12	M8 × 80 mm
20	Rubber seal	6	
21	Fuel injector	6	
22	Grommet	6	<b>Not reusable</b>
23	O-ring	6	<b>Not reusable</b> 2.1 × 11.8 mm
24	Collar	6	
25	Bolt	6	M8 × 45 mm
26	O-ring	1	<b>Not reusable</b>
27	Screw	2	M6 × 12 mm
28	Cap	1	
29	Fuel hose	1	
30	Hose	6	
31	Joint	1	
32	Plastic tie	1	
33	Joint	1	

4



## Throttle control



S69J4160

## Throttle control

No.	Part name	Q'ty	Remarks
1	Bracket	1	
2	Joint	1	
3	Magnet control lever	1	
4	Pin	4	
5	Shaft	1	
6	Bracket	1	
7	Bolt	2	M6 × 20 mm
8	Washer	2	
9	Bushing	5	
10	Gear	2	
11	Throttle control lever	1	
12	Circlip	1	
13	Bolt	1	
14	Wave washer	1	
15	Washer	1	
16	Throttle cam	1	
17	Spring	1	
18	Bolt	2	M6 × 14 mm
19	Bracket	2	
20	Bolt	1	M8 × 20 mm
21	Terminal	1	
22	Starter motor lead	1	
23	Bolt	1	M6 × 14 mm
24	Bolt	5	M6 × 45 mm

4

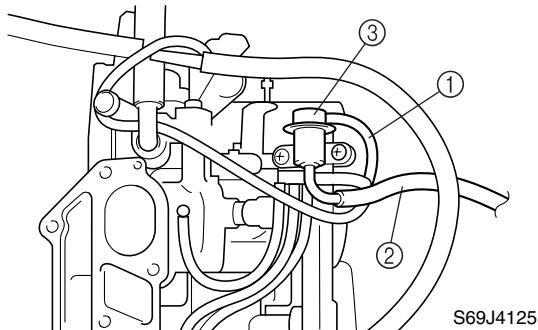
## FUEL



## Fuel system

### Removing the pressure regulator

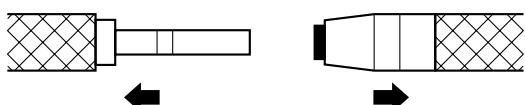
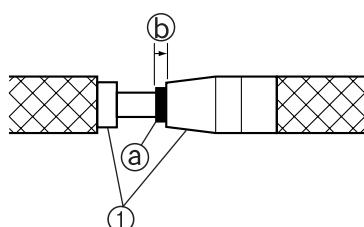
1. Remove the intake silencer and the port intake manifold.
2. Disconnect the hose ① and ②, and then remove the pressure regulator ③.



S69J4125

### Disconnecting the high-pressure fuel hose joint

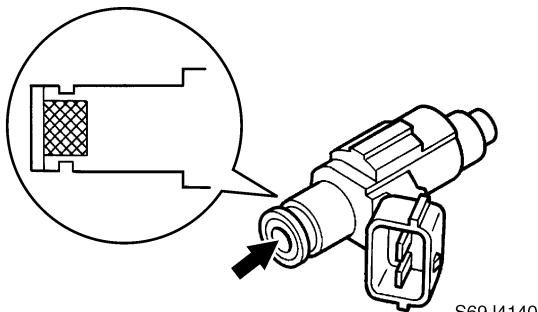
1. Disconnect the high-pressure fuel hose joint ① with the collar ② slide from the end ③ of the joint.



S69J4130

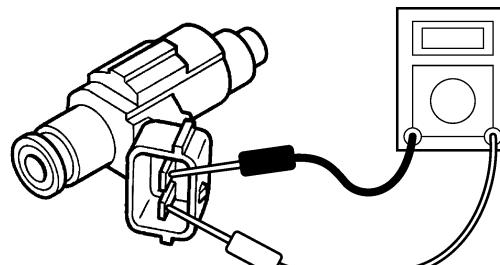
### Checking the fuel injector

1. Check the filter for dirt or residue. Clean if necessary.



S69J4140

2. Measure the resistance of the fuel injections. Replace if out of specification.



S69J4150



Digital multimeter: YU-34899-A



Fuel injector resistance

(use as reference):

14.0–15.0  $\Omega$  at 20 °C (68 °F)

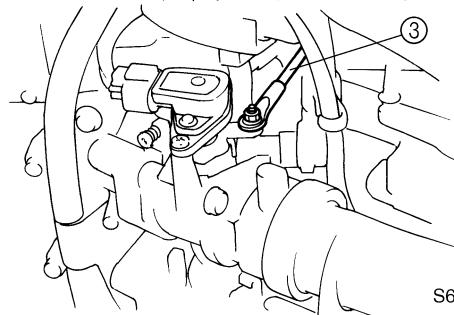
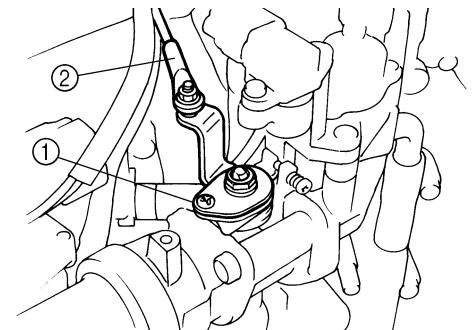
3. Check the operation of the fuel injector using the “Stationary Test” of the Yamaha Diagnostic System.

### Checking the idle speed control (ISC)

1. Check the operation of the idle speed control using the “Stationary test” or the “Active test” of the Yamaha Diagnostic System.

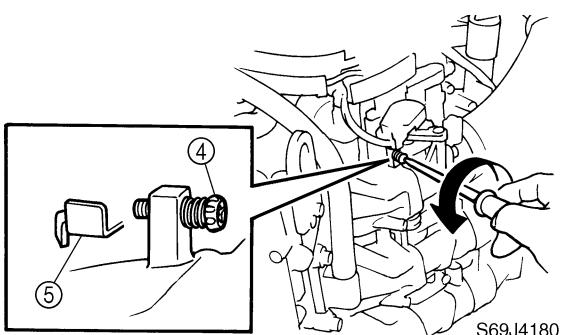
### Synchronizing the throttle valve

1. Loosen the bank synchronizing screw ①.
2. Remove the port link rod ② and starboard link rod ③.



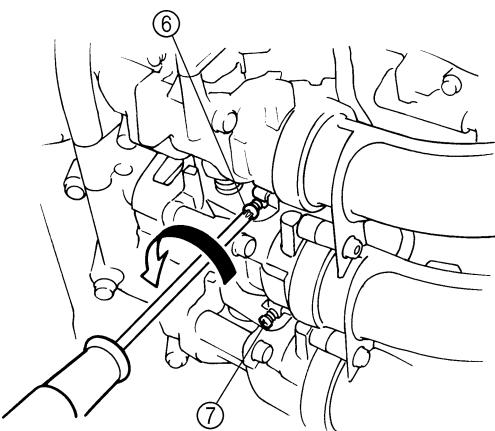
S69J4170

3. Loosen the starboard throttle stop screw ④ until it separates from the throttle body lever ⑤.



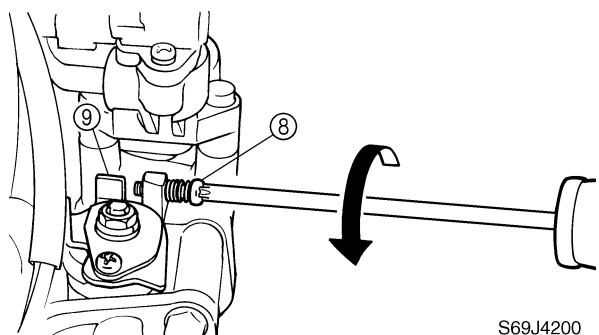
S69J4180

4. Loosen the synchronizing screw ⑥ of cylinder #3 to open throttle valve #3.
5. Loosen the synchronizing screw ⑦ of cylinder #5 to open throttle valve #5.



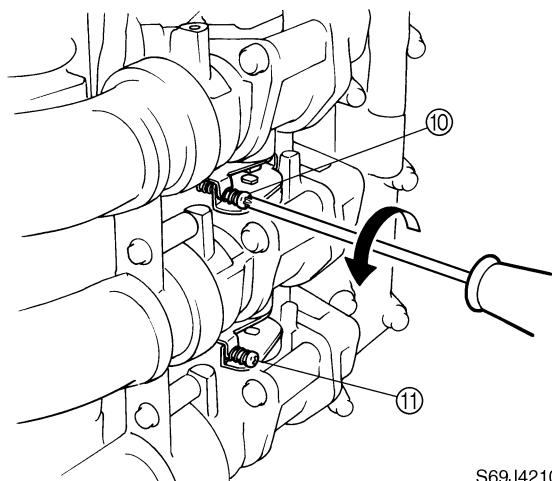
S69J4190

6. Loosen the port throttle stop screw ⑧ until it separates from the throttle body lever ⑨.



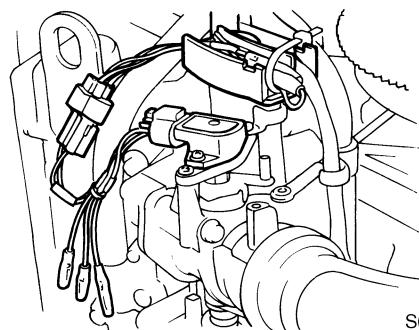
S69J4200

7. Loosen the synchronizing screw ⑩ of cylinder #4 to open throttle valve #4.
8. Loosen the synchronizing screw ⑪ of cylinder #6 to open throttle valve #6.



S69J4210

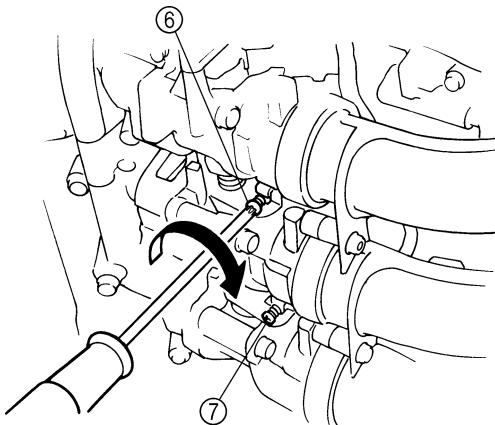
9. Connect the test harness (3 pins) to the throttle position sensor.

**FUEL****Fuel system**

S69J4220

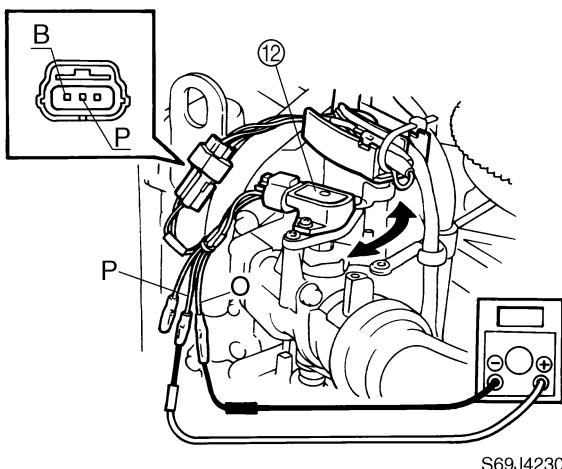


Test harness (3 pins): YB-06793



S69J4240

10. Turn the engine start switch to ON.
11. Measure the throttle position sensor output voltage. Adjust the throttle position sensor ⑫ position if out of specification.

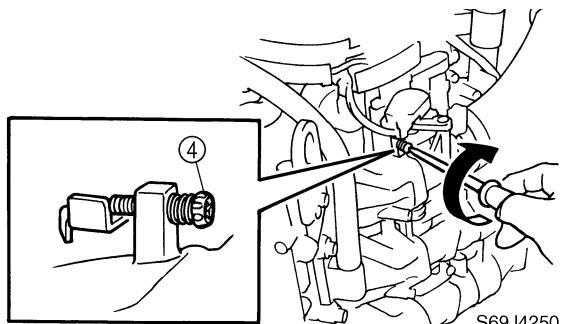


S69J4230



Digital multimeter: YU-34899-A

13. Tighten the starboard throttle stop screw ④ until the output voltage is adjusted to specification as mentioned in step 11, plus 40 mV.



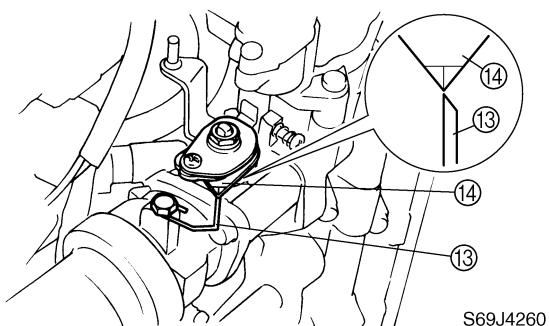
S69J4250



Throttle position sensor output voltage:

Pink (P) – Black (B)  
 $700 \pm 5 \text{ mV}$ 

14. Attach a synchronizing check tool ⑬ as shown to the port #2 throttle body (to facilitate the monitoring of the throttle plate ⑭ movement).

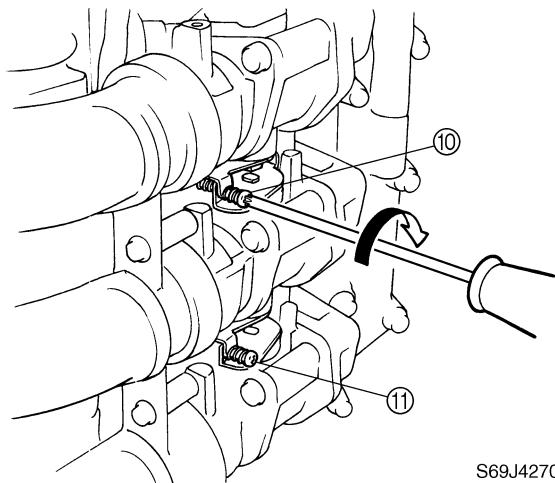


S69J4260

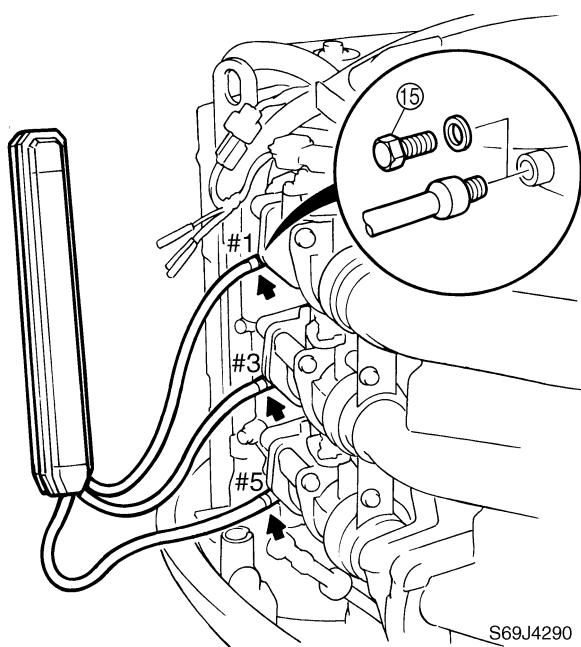
12. Tighten the synchronizing screw ⑥ of cylinder #3 and stop tightening it when the throttle position sensor output voltage starts to change. Similarly, tighten and adjust the synchronizing screw ⑦ of cylinder #5.

## Throttle control

15. Tighten the synchronizing screw ⑩ of cylinder #4, and stop tightening when the throttle plate starts to move. Similarly, tighten and adjust the synchronizing screw ⑪ of cylinder #6.

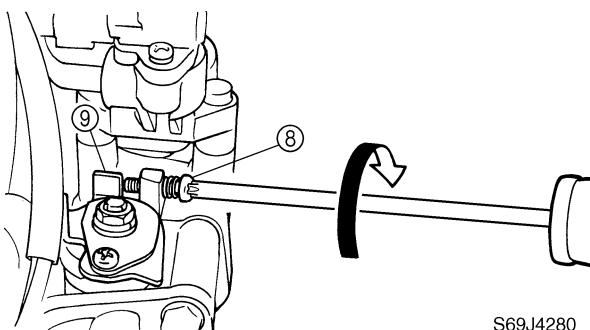


S69J4270



S69J4290

16. Tighten the port throttle stop screw ⑧ until it contacts the throttle body lever ⑨, and then turn it one additional turn.



S69J4280

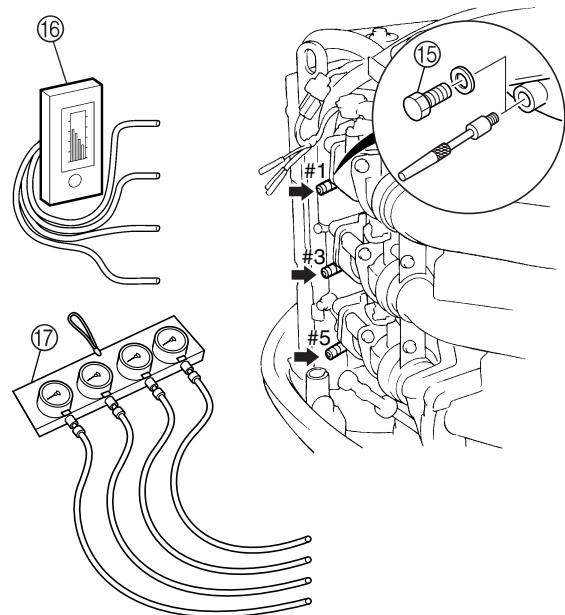


Carburetor synchronizer: YU-08030

**4**

17. Start the engine and warm it up for 5 minutes.

18. Remove the plugs ⑯ of cylinders #1, #3, and #5, and then attach the special service tool and adapters to the intake manifold as shown.



S69J4310

### NOTE:

For best results, use a vacuum gauge (commercially obtainable), like ⑯ or ⑰ shown in the illustration, that has four adapters.

**FUEL****Fuel system**

19. Measure the vacuum of cylinders #1, #3, and #5. Repeat step 12 if out of specification.

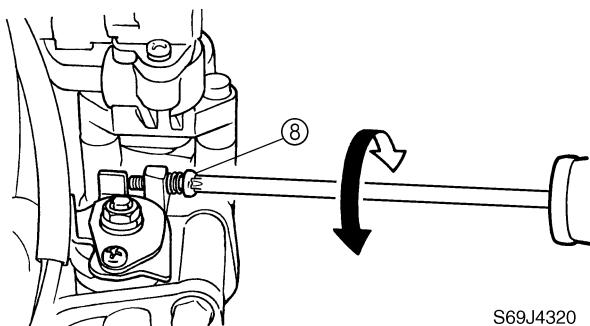


Vacuum difference between cylinders:

20 mmHg (27 mbar, 0.79 inHg)

20. Measure the vacuum of cylinders #2, #4, and #6. Repeat step 12 if out of specification.

21. Check the average vacuum difference between the port and starboard banks. Adjust the port throttle stop screw ⑧ if out of specification.



Average vacuum difference between port and starboard banks:

40 mmHg (53 mbar, 1.57 inHg)

22. Measure the throttle position sensor output voltage when the engine speed is at idle. Adjust the throttle position sensor position if out of specification.



Throttle position sensor output voltage:

Pink (P) – Black (B)  
700 ± 5 mV at idle speed  
(700 r/min)

23. Install the port link rod ② and starboard link rod ③.



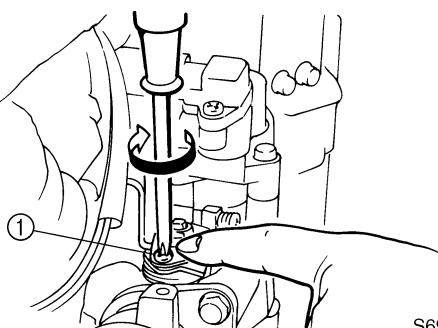
S69J4330



Link rod nut:

4 N·m (0.4 kgf·m, 2.9 ft·lb)

24. Tighten the bank synchronizing screw ①.

**NOTE:**

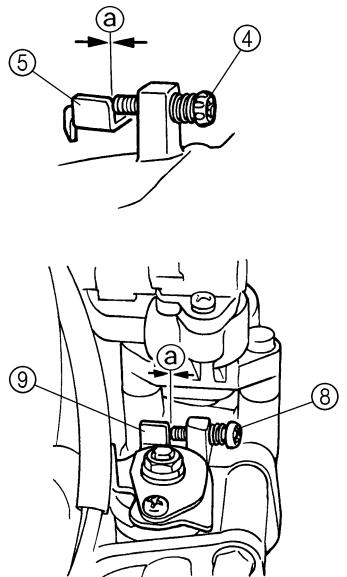
Tighten the screw without tilting the plate.



Bank synchronizing screw:

4 N·m (0.4 kgf·m, 2.9 ft·lb)

25. Check that there is no clearance ① between the port and starboard throttle stop screws ④ and ⑧, and the throttle body levers ⑤ and ⑨. If there is any clearance, repeat step 24.



S69J4350

4

26. Start the engine, and when the engine speed is at idle, check the average vacuum difference between the port and starboard banks. Adjust if out of specification.



Average vacuum difference between port and starboard banks:  
40 mmHg (53 mbar, 1.57 inHg)



## Power unit

<b>Special service tools .....</b>	<b>5-1</b>
<b>Power unit.....</b>	<b>5-3</b>
Checking the compression pressure .....	5-14
Checking the oil pressure .....	5-14
Checking the oil pressure sensor .....	5-15
Checking the valve clearance.....	5-15
Replacing the timing belt .....	5-21
Removing the power unit.....	5-23
Removing the oil filter .....	5-25
Removing the timing belt and sprockets.....	5-25
Checking the timing belt and sprockets.....	5-26
Installing the sprockets and timing belt.....	5-27
<b>Cylinder head .....</b>	<b>5-29</b>
Removing the cylinder head .....	5-33
Checking the valve springs.....	5-34
Checking the valves .....	5-34
Checking the valve guides.....	5-35
Replacing the valve guides.....	5-35
Checking the valve seat .....	5-36
Refacing the valve seat .....	5-36
Checking the camshaft .....	5-38
Checking the timing chain tensioner.....	5-39
Checking the timing chain .....	5-39
Checking the cylinder head .....	5-39
Installing the valves .....	5-40
Installing the cylinder head .....	5-41

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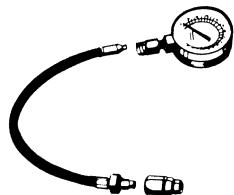
<b>Cylinder block .....</b>	<b>5-43</b>
Disassembling the cylinder block .....	5-47
Checking the piston diameter .....	5-47
Checking the cylinder bore .....	5-48
Checking the piston clearance .....	5-48
Checking the piston rings .....	5-48
Checking the piston ring grooves .....	5-49
Checking the piston ring side clearance .....	5-49
Checking the piston pin boss bore .....	5-49
Checking the piston pin .....	5-50
Checking the connecting rod small end inside diameter .....	5-50
Checking the connecting rod big end side clearance .....	5-50
Checking the crankshaft .....	5-50
Checking the crankpin oil clearance .....	5-51
Selecting the connecting rod bearing .....	5-52
Checking the crankshaft main journal oil clearance .....	5-53
Selecting the crankshaft main bearing .....	5-54
Disassembling the oil pump.....	5-55
Checking the oil pump .....	5-55
Assembling the oil pump .....	5-55
Assembling the piston and cylinder block.....	5-56
Checking the thermostat.....	5-60
Installing the power unit.....	5-60

**POWR**

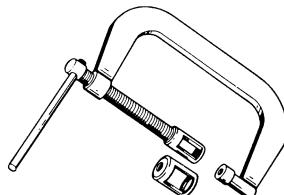


**Power unit**

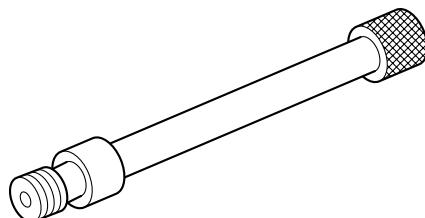
## Special service tools



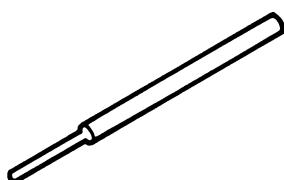
**Compression gauge**  
YU-33223-1



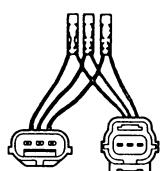
**Valve spring compressor**  
YM-01253  
**Valve spring compressor attachment**  
YB-06320



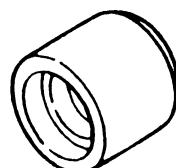
**Compression gauge extension**  
YB-06563



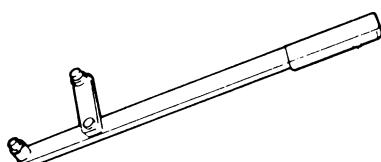
**Valve guide remover**  
YB-06801



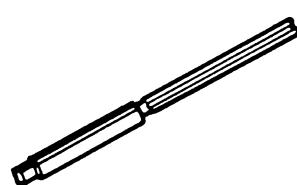
**Test harness (3 pins)**  
YB-06769



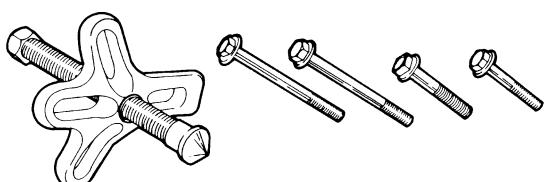
**Valve guide installer**  
YB-06810



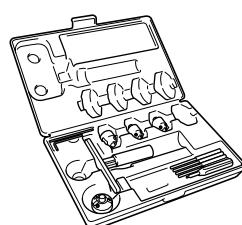
**Flywheel magnet holder**  
YB-06139



**Valve guide reamer**  
YB-06804



**Universal puller**  
YB-06117

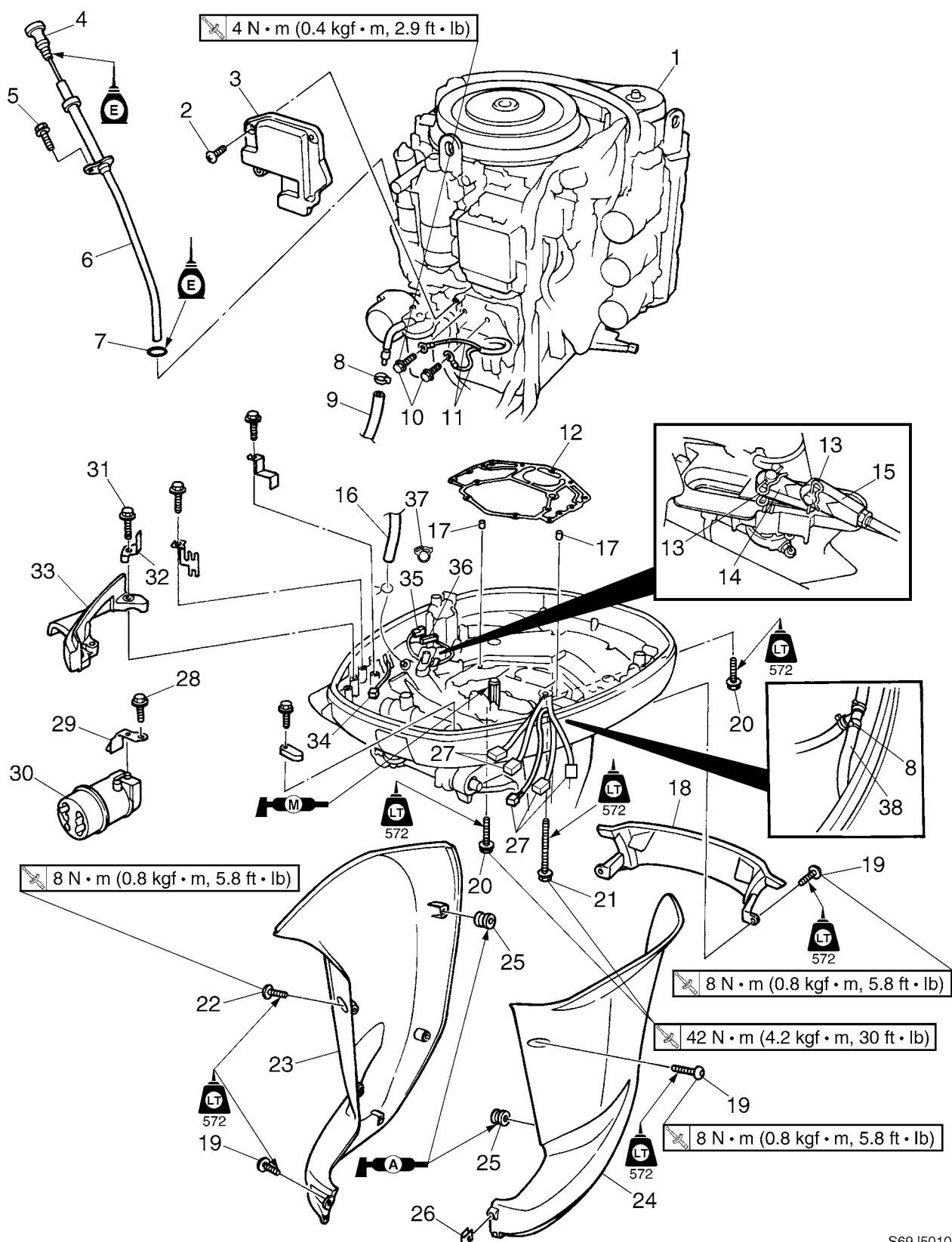


**Valve seat cutter set**  
YB-91044



**Piston ring compressor**  
**YM-08037**

**5**

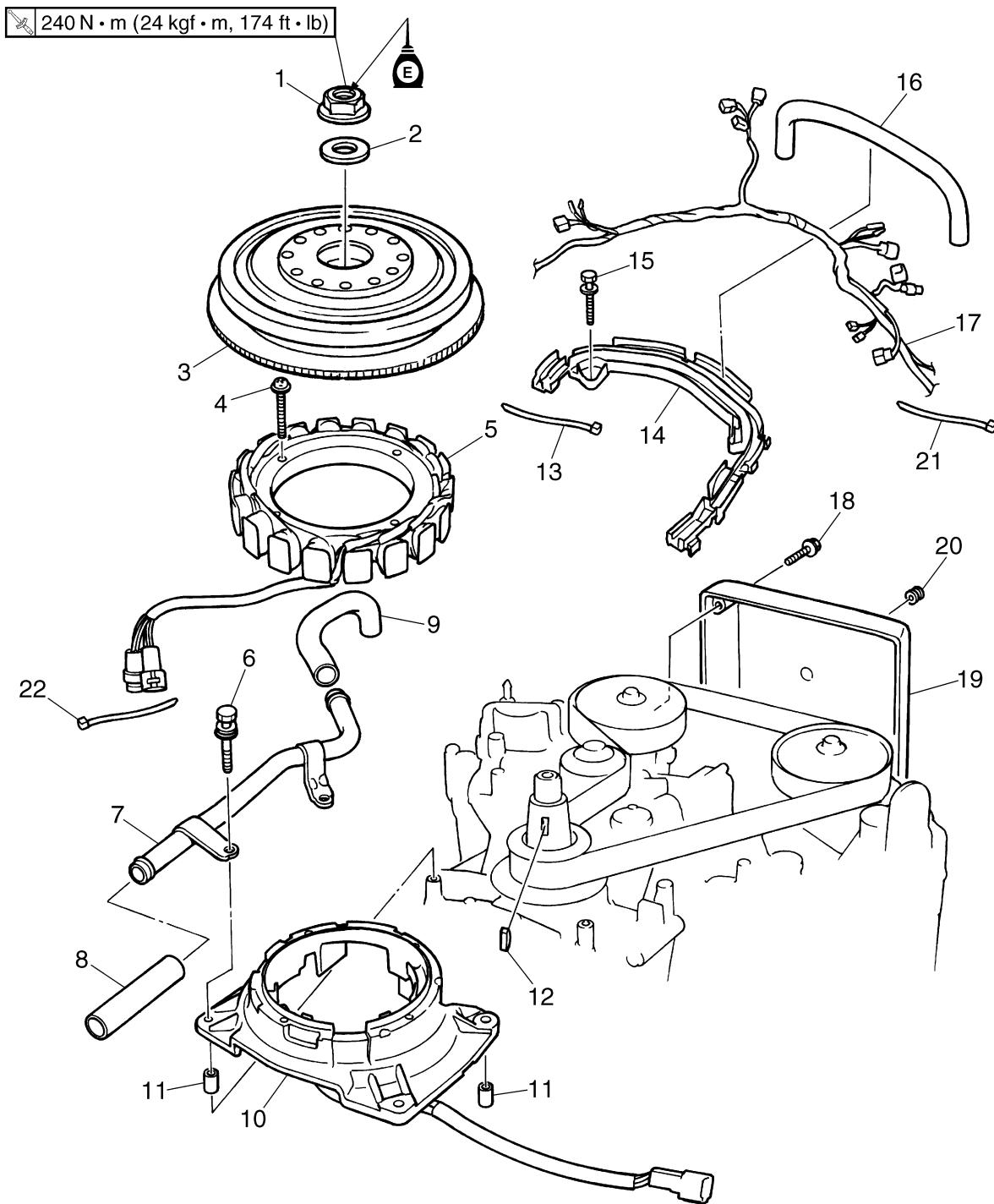
**POWR****Power unit****Power unit**

S69J5010U

## Power unit

No.	Part name	Q'ty	Remarks
1	Power unit	1	
2	Screw	4	
3	Cover	1	
4	Dipstick	1	
5	Bolt	1	M6 × 20 mm
6	Dipstick guide	1	
7	O-ring	1	Not reusable
8	Plastic tie	2	Not reusable
9	Fuel hose	1	
10	Bolt	2	M6 × 10 mm
11	PTT motor lead	2	Sky blue, light green
12	Gasket	1	Not reusable
13	Clip	2	
14	Shift cable	1	
15	Throttle cable	1	
16	Cooling water pilot hose	1	
17	Dowel pin	2	
18	Upper case cover	1	
19	Bolt	7	M6 × 14 mm
20	Bolt	7	M9 × 35 mm
21	Bolt	6	M10 × 140 mm
22	Bolt	1	M6 × 30 mm
23	Starboard apron	1	
24	Port apron	1	
25	Grommet	6	
26	Nut	2	
27	Fuel pump driver and isolator coupler	5	
28	Bolt	1	M6 × 20 mm
29	Holder	1	
30	Grommet	1	
31	Bolt	1	M6 × 30 mm
32	Holder	1	
33	Retaining plate	1	
34	PTT switch coupler	1	
35	Shift cut switch coupler	1	
36	Neutral switch coupler	1	
37	Clamp	1	
38	Flushing device hose	1	Flushing device model

5

**POWR****Power unit**

S69J5020

## Power unit

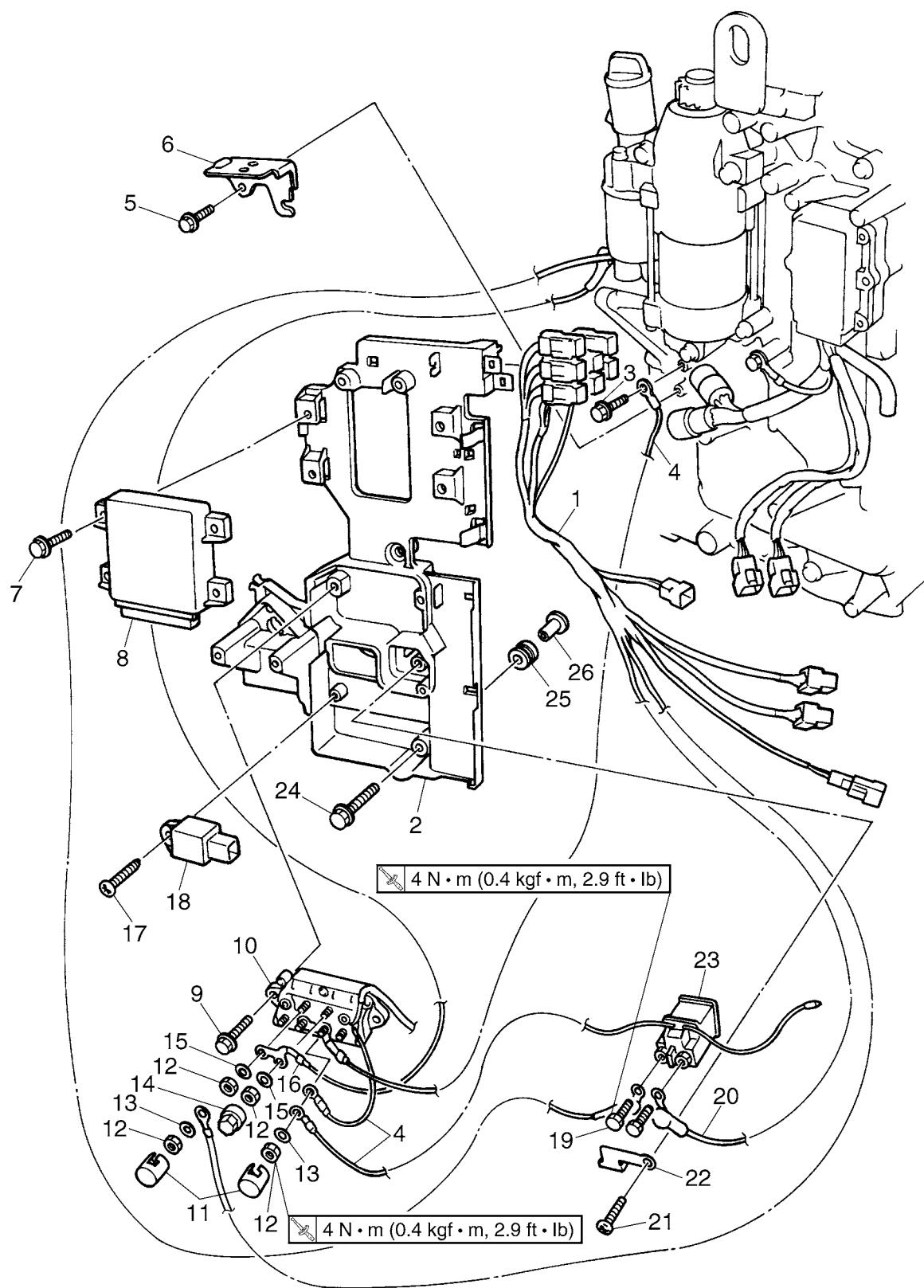
No.	Part name	Q'ty	Remarks
1	Nut	1	
2	Washer	1	
3	Flywheel magnet	1	
4	Screw	4	M6 × 30 mm
5	Stator coil	1	
6	Bolt	4	M6 × 35 mm
7	Blowby hose guide	1	
8	Blowby hose	1	
9	Blowby hose	1	
10	Stator coil bracket	1	
11	Collar	2	
12	Woodruff key	1	
13	Plastic tie	5	<b>Not reusable</b>
14	Wiring harness guide	1	
15	Bolt	3	M6 × 35 mm
16	Idle speed control hose	1	
17	Wiring harness	1	
18	Bolt	4	
19	Ignition coil cover	1	
20	Grommet	2	
21	Plastic tie	5	<b>Not reusable</b>
22	Plastic tie	2	<b>Not reusable</b>

5

POWR



Power unit



S69J5030U

## Power unit

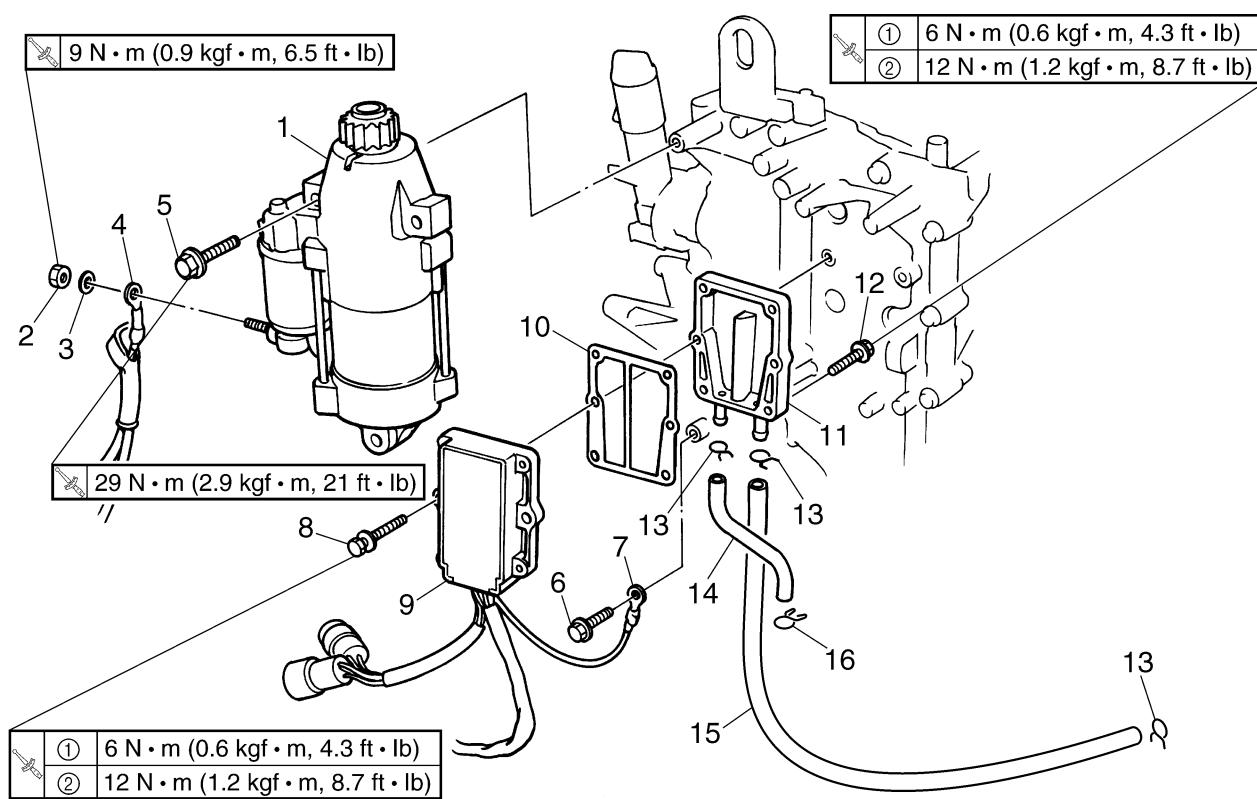
No.	Part name	Q'ty	Remarks
1	Wiring harness	1	
2	Bracket	1	
3	Bolt	1	M6 × 20 mm
4	Ground lead	3	
5	Bolt	1	M6 × 16 mm
6	Bracket	1	
7	Bolt	4	M6 × 16 mm
8	ECM	1	
9	Bolt	2	M6 × 25 mm
10	Power trim and tilt relay	1	
11	Cap	2	
12	Nut	4	
13	Washer	2	
14	Cap	1	
15	Spring washer	2	
16	Battery lead	1	Red
17	Screw	1	
18	Main relay	1	
19	Bolt	2	M6 × 10 mm
20	Starter motor lead	1	Brown/white
21	Screw	1	
22	Holder	1	
23	Starter relay	1	
24	Bolt	6	M6 × 28 mm
25	Grommet	6	
26	Collar	6	

5

POWR

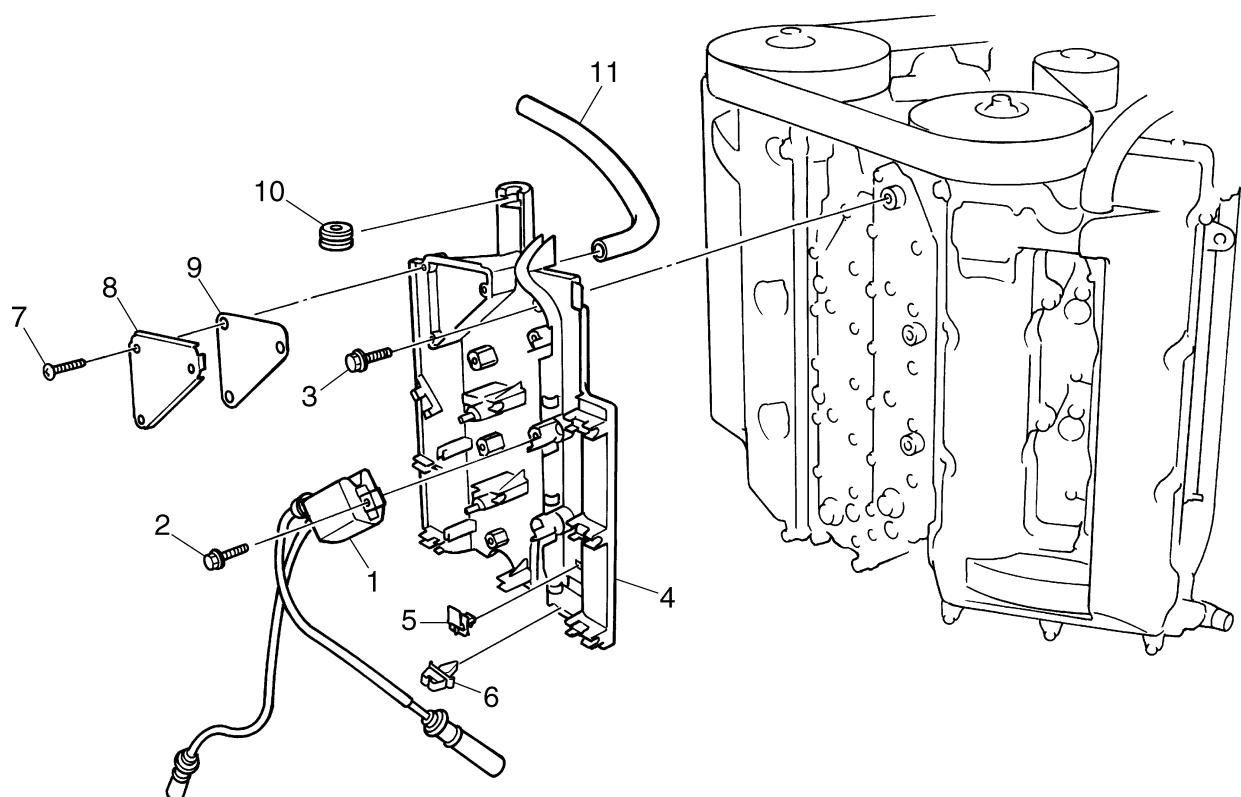


## Power unit



S69J5040

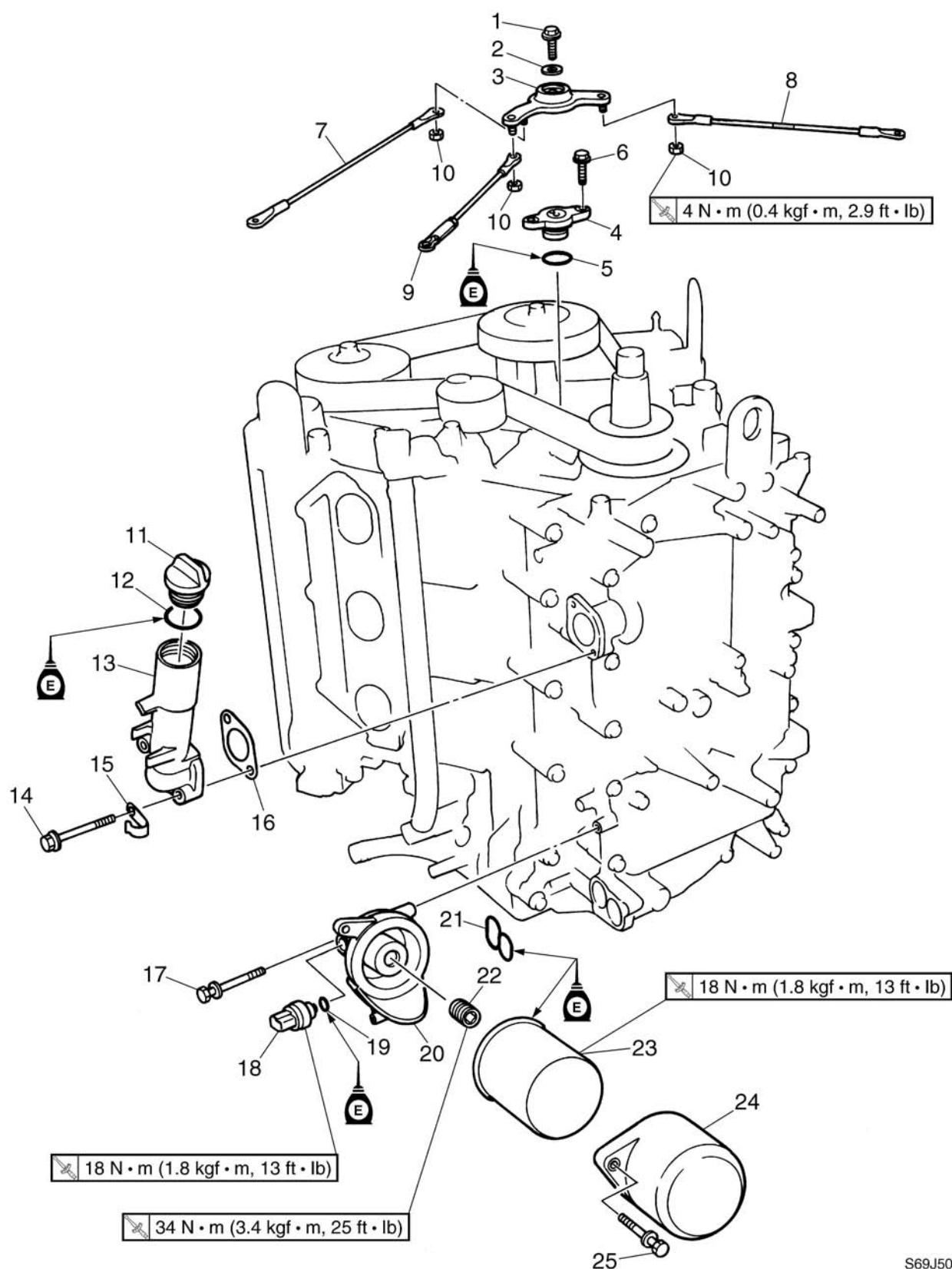
No.	Part name	Q'ty	Remarks
1	Starter motor	1	
2	Nut	1	
3	Spring washer	1	
4	Battery cable	1	From terminal and power trim and tilt relay
5	Bolt	3	M8 × 45 mm
6	Bolt	1	M6 × 20 mm
7	Ground lead	1	
8	Bolt	2	M6 × 35 mm
9	Rectifier Regulator	1	
10	Gasket	1	<b>Not reusable</b>
11	Cover	1	
12	Bolt	4	M6 × 25 mm
13	Clip	3	
14	Cooling water hose	1	Out
15	Cooling water hose	1	In
16	Clip	1	



S69J5050

**5**

No.	Part name	Q'ty	Remarks
1	Ignition coil	3	
2	Bolt	6	M6 × 20 mm
3	Bolt	6	M6 × 20 mm
4	Bracket	1	
5	Clamp	3	
6	Clamp	3	
7	Screw	3	M6 × 20 mm
8	Plate	1	
9	Gasket	1	
10	Grommet	1	
11	Idle speed control hose	1	

**POWR****Power unit**

S69J5060

## Power unit

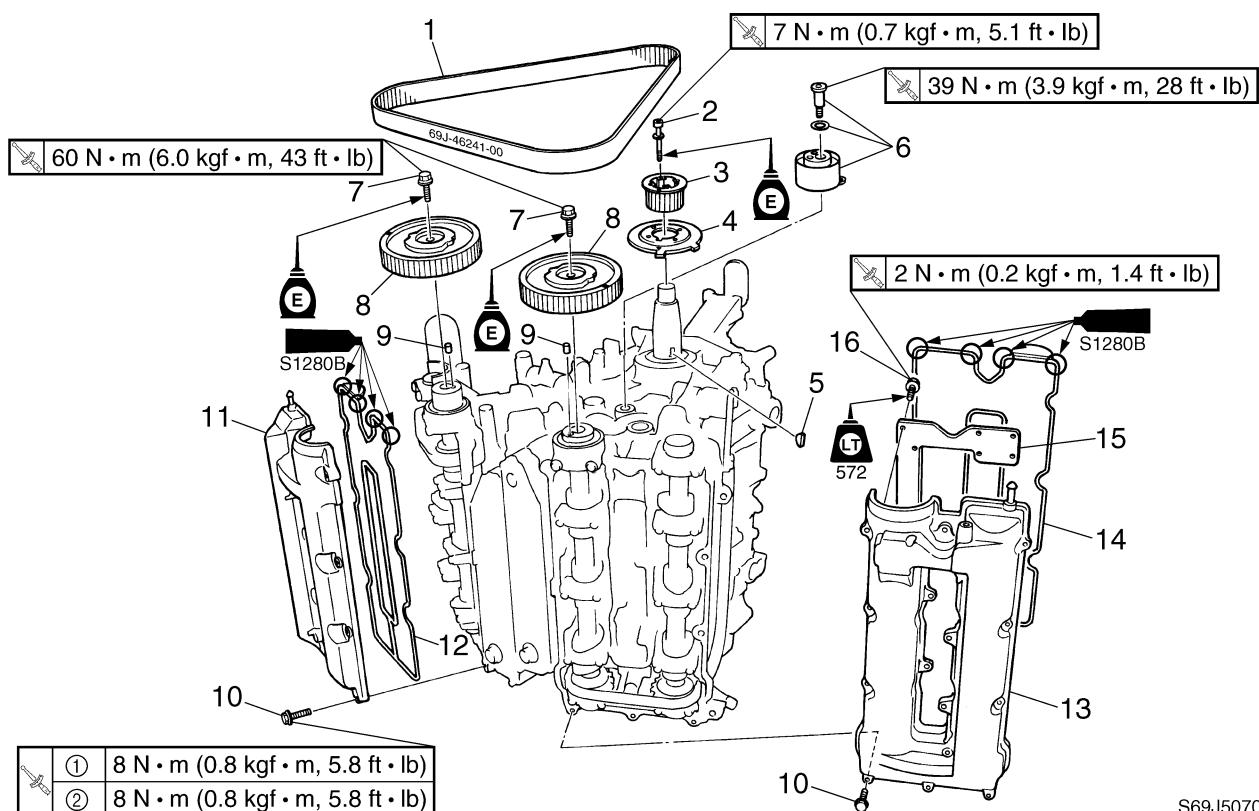
No.	Part name	Q'ty	Remarks
1	Bolt	1	M6 × 30 mm
2	Washer	1	
3	Link rod arm	1	
4	Plug	1	
5	O-ring	1	<b>Not reusable</b>
6	Bolt	2	M6 × 20 mm
7	Link rod	1	Long
8	Link rod	1	Short
9	Link rod	1	
10	Nut	3	
11	Oil filler cap	1	
12	O-ring	1	<b>Not reusable</b>
13	Oil filler neck	1	
14	Bolt	2	M6 × 45 mm
15	Clamp	1	
16	Gasket	1	<b>Not reusable</b>
17	Bolt	3	M6 × 45 mm
18	Oil pressure sensor	1	
19	O-ring	1	<b>Not reusable</b>
20	Oil filter bracket	1	
21	Gasket	1	<b>Not reusable</b>
22	Bolt	1	
23	Oil filter	1	
24	Oil filter cover	1	
25	Bolt	1	M6 × 40 mm

5

POWR



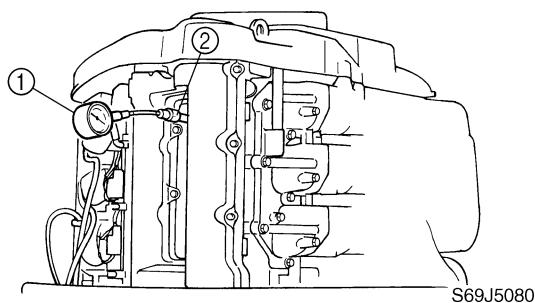
## Power unit



No.	Part name	Q'ty	Remarks
1	Timing belt	1	
2	Bolt	4	M5 × 45 mm
3	Drive sprocket	1	
4	Plate	1	
5	Woodruff key	1	
6	Timing belt tensioner	1	
7	Bolt	2	M10 × 35 mm
8	Driven sprocket	2	
9	Dowel pin	2	
10	Bolt	28	M6 × 30 mm
11	Port cylinder head cover	1	
12	Gasket	1	<b>Not reusable</b>
13	Starboard cylinder head cover	1	
14	Gasket	1	<b>Not reusable</b>
15	Plate	1	
16	Screw	8	M4 × 8 mm

## Checking the compression pressure

- Start the engine, warm it up for 5 minutes, and then turn it off.
- Remove the clip from the engine stop lanyard switch on the remote control box.
- Remove the ignition coil cover and all spark plugs, and then install the special service tools to each spark plug hole.



### CAUTION:

**Before removing the spark plugs, blow compressed air in the spark plug well to clear out any dirt or dust that may fall into the cylinder.**



Compression gauge ①: YU-33223-1

Compression gauge extension ②:

YB-06563

- Fully open the throttle, crank the engine until the reading on the compression gauge stabilizes, and then check the compression pressure.



Minimum compression pressure  
(reference data):

880 kPa (8.8 kgf/cm<sup>2</sup>, 125 psi)

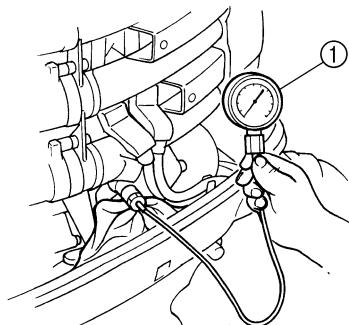
- If the compression pressure is below specification and the compression pressure for each cylinder is unbalanced, add a small amount of engine oil to the cylinder, and then check the pressure again.

### NOTE:

- If the compression pressure increases, check the piston and piston rings for wear. Replace if necessary.
- If the compression pressure does not increase, check the valve clearance, valve, valve seat, cylinder sleeve, cylinder head gasket, and cylinder head. Adjust or replace if necessary.

## Checking the oil pressure

- Place a rag under the oil pressure sensor.
- Remove the intake silencer and oil pressure sensor, and then install an oil pressure gauge ① to the oil pressure sensor installation hole.



S69J5090

### NOTE:

Use a pressure gauge with an adapter that has a 1/8 pitch thread.

- Install the intake silencer.

### CAUTION:

**Do not start the engine when the intake silencer is not installed.**

- Start the engine and warm it up for 5 minutes.

**POWR**

## Power unit

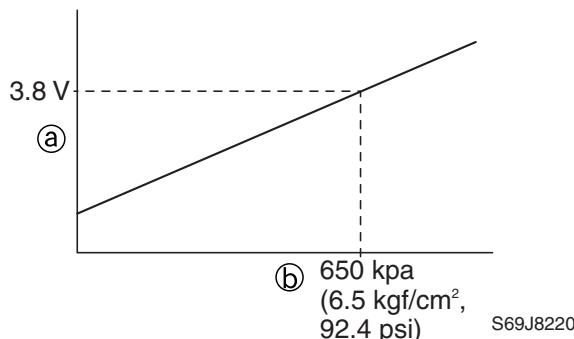
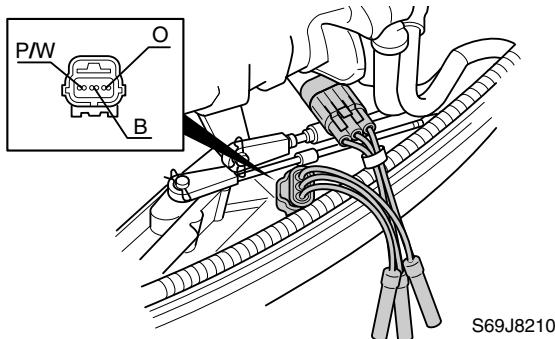
- Check the oil pressure. Check the oil pump, oil leakage, and oil strainer if out of specification.



**Oil pressure (reference data):**  
650 kPa (6.5 kgf/cm<sup>2</sup>, 92.4 psi) at idle speed (700 r/min)

### Checking the oil pressure sensor

- Connect the test harness (3 pins) to the oil pressure sensor.
- Start the engine and warm it up for 5 minutes.
- Measure the oil pressure sensor input voltage. Check the wiring harness connection or replace the ECM if out of specification.
- Measure the oil pressure sensor output voltage. Replace if out of specification.



(a): Output voltage  
(b): Oil pressure



**Test harness (3 pins): YB-06769**



**Oil pressure sensor input voltage:**

Orange (O) – Black (B)

5 V

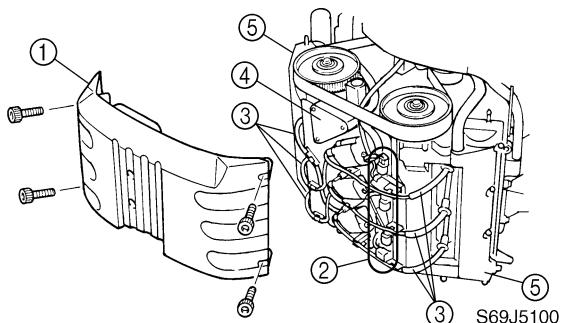
**Oil pressure sensor output voltage (reference data):**

Pink/white (P/W) – Black (B)

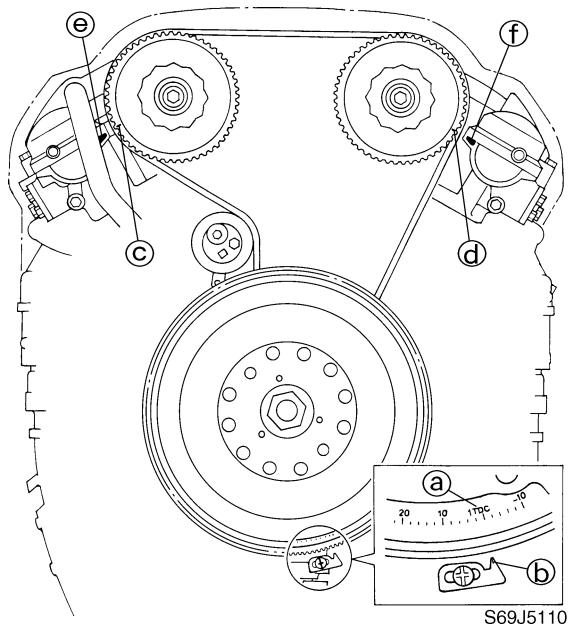
3.8 V at idle speed (700 r/min)

### Checking the valve clearance

- Remove the flywheel magnet cover and ignition coil cover ①.
- Disconnect the ignition coil couplers ② and spark plug caps ③, and remove the ignition coil bracket ④, spark plugs, and cylinder head covers ⑤.

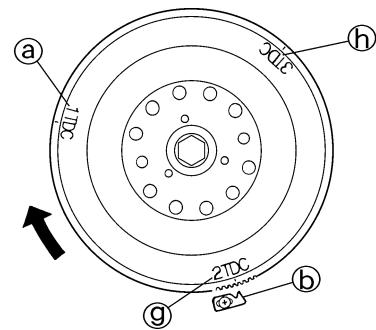


- Turn the flywheel magnet clockwise and align the “1TDC” mark ⑥ on the flywheel magnet with the pointer ⑦, and check that “I” marks ⑧ and ⑨ on the driven sprockets are aligned with marks ⑩ and ⑪.

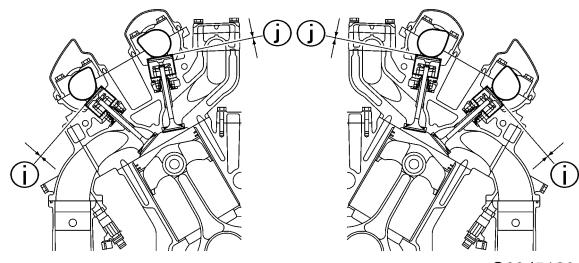
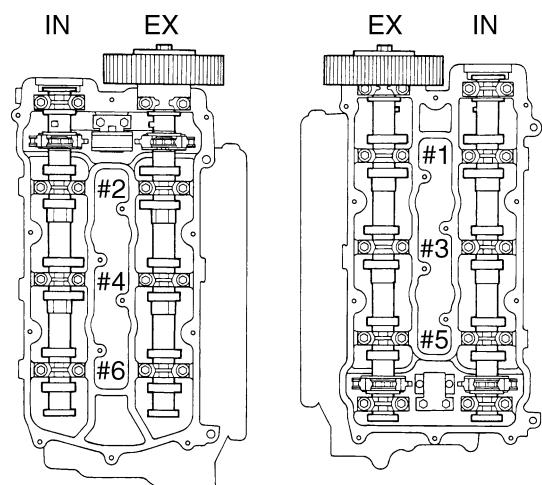


**NOTE:**  
Do not turn the flywheel magnet counter-clockwise.

4. Check the intake and exhaust valve clearance for cylinder #4.
5. Turn the flywheel magnet an additional  $120^\circ$  clockwise and align the "2TDC" mark ⑨ on the flywheel magnet with the pointer ⑩.
6. Check the intake and exhaust valve clearance for cylinder #5.
7. Turn the flywheel magnet an additional  $120^\circ$  clockwise and align the "3TDC" mark ⑪ on the flywheel magnet with the pointer ⑫.
8. Check the intake and exhaust valve clearance for cylinder #6.



9. Similarly, check the valve clearance of cylinders #1, #2, and #3 in order, and be sure to turn the flywheel magnet  $120^\circ$  clockwise each time. Adjust if out of specification.



**NOTE:**

- Check the valve clearance when the engine is cold.
- Note the measurement.



Valve clearance:

Intake ⑬:

$0.20 \pm 0.03$  mm ( $0.008 \pm 0.001$  in)

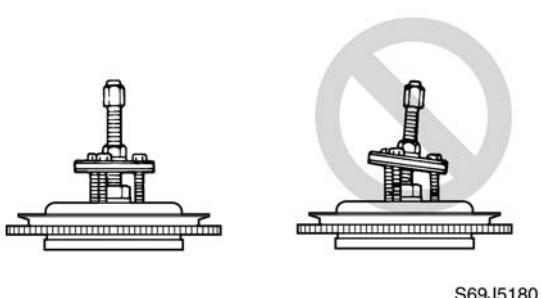
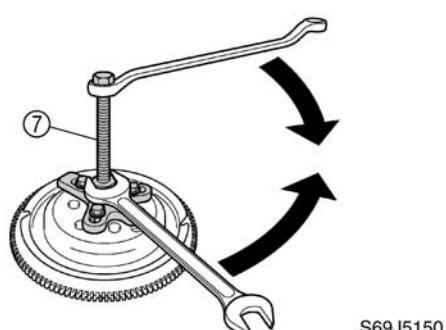
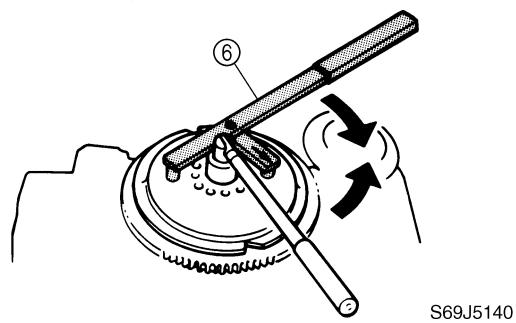
Exhaust ⑭:

$0.34 \pm 0.03$  mm ( $0.013 \pm 0.001$  in)

5



10. Turn the flywheel magnet an additional 120° clockwise and align the "1TDC" mark on the flywheel magnet with the pointer, and check that the "I" marks on the driven sprockets are aligned with the alignment marks on the cylinder head.
11. Remove the flywheel magnet.

**CAUTION:**

- Apply force in the direction of the arrows shown, to prevent the flywheel holder from slipping off easily.
- To prevent damage to the engine or tools, screw in the flywheel puller set bolts evenly and completely so that the flywheel puller plate is parallel to the flywheel magnet.

**NOTE:**

Apply force to the crankshaft end until the flywheel magnet comes off the tapered portion of the crankshaft.

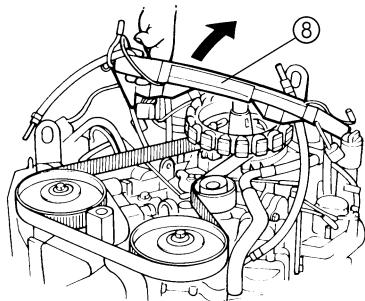


Flywheel magnet holder ⑥:

YB-06139

Universal puller ⑦: YB-06117

12. Remove the wiring harness guide bolts.



S69J5190

**NOTE:**

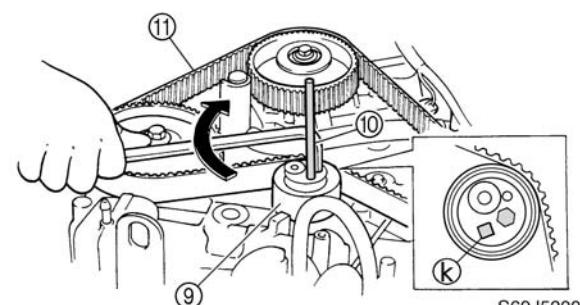
Move the wiring harness guide ⑧ to a position that will make servicing easy.

13. Using a hexagon wrench, turn the timing belt tensioner ⑨ clockwise to push the timing belt, increase strength gradually, and then insert a ø5.0 mm (0.2 in) pin ⑩ into the hole ⑪.

**NOTE:**

Leave the pin inserted into the timing belt tensioner until the timing belt has been installed.

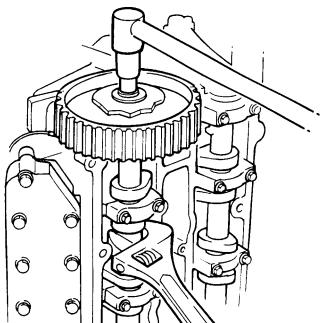
14. Remove the timing belt ⑫ from the driven sprockets.



S69J5200

## Power unit

15. Remove the driven sprockets.

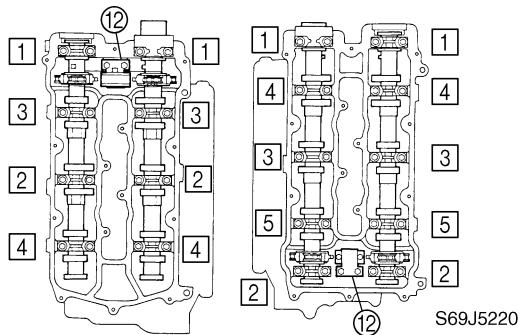


S69J5210

**NOTE:**

Hold the camshaft with a wrench, and be careful not to damage the driven sprocket.

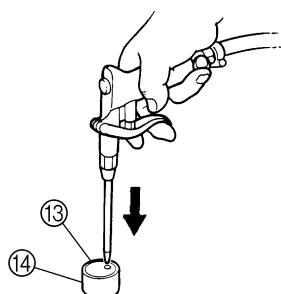
16. Remove the timing chain tensioners ⑫, then the camshaft caps in the order shown in the illustration.



S69J5220

17. Remove the camshafts and timing chains.

18. Remove the valve shim ⑬ from the valve lifter ⑭ using compressed air.



S69J5230

**NOTE:**

Do not mix the valve train parts. Keep them organized in their proper groups.

19. Measure the valve shim thickness with a micrometer, and then note the measurement.

20. Select the necessary valve shim by calculating its thickness with the following formula.

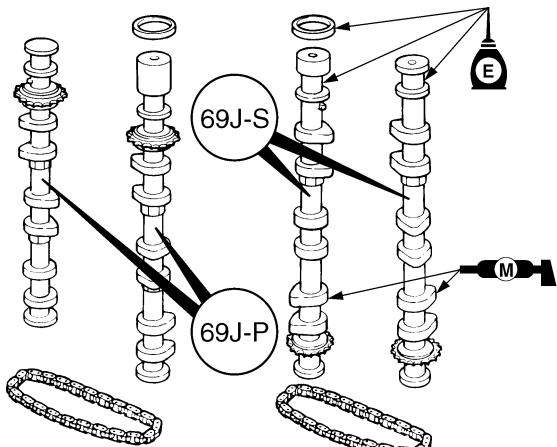
$$\begin{aligned} \text{Necessary valve shim thickness} = \\ \text{Removed valve shim thickness} + \\ \text{Measured valve clearance} - \text{Specified} \\ \text{valve clearance} \end{aligned}$$

**Example:**

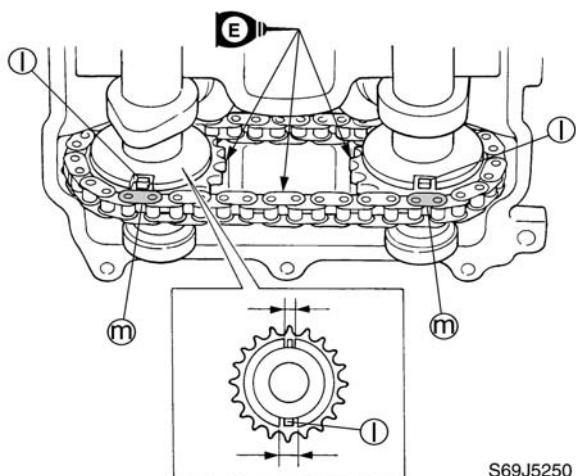
If the "Removed valve shim thickness" is 2.10 mm, the "Checked valve clearance" is 0.30 mm and the "Specified valve clearance" is 0.20 mm, then the "Necessary valve shim thickness" =  $2.10 + 0.30 - 0.20 = 2.20$  mm

21. Install the necessary valve shim into the valve lifter.

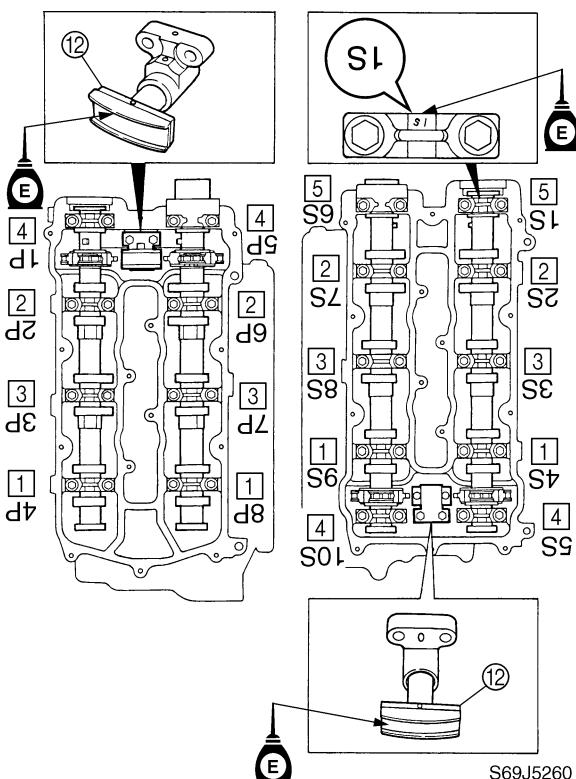
22. Align the projection (wide one) ① on the camshaft sprockets to the alignment plate (gold) ⑩ on the timing chain, and then install the camshafts to the cylinder head with new oil seals.



S69J5240



23. Install the camshaft caps, and then tighten them to the specified torque in the order shown in the illustration.
24. Install the timing chain tensioners ⑫, and then tighten the bolts to the specified torque in the sequence shown.

**NOTE:**

- Install the camshaft caps in the proper position as shown and with the stamped numbers facing upside down.
- Apply engine oil to the camshaft cap bolts before installation.



Camshaft cap bolt:

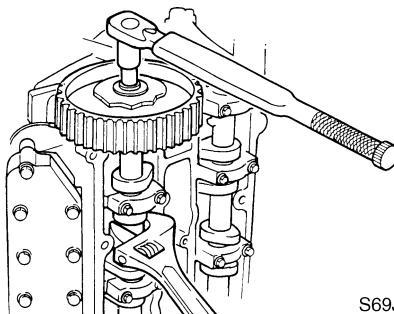
1st: 8 N·m (0.8 kgf·m, 5.8 ft·lb)

2nd: 17 N·m (1.7 kgf·m, 12 ft·lb)

Timing chain tensioner bolt:

12 N·m (1.2 kgf·m, 8.7 ft·lb)

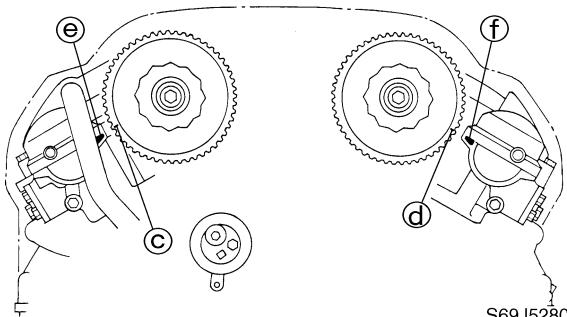
25. Install the driven sprockets, and then tighten the bolts to the specified torque.



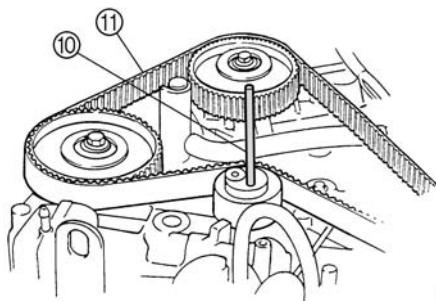
Driven sprocket bolt:

60 N·m (6.0 kgf·m, 43 ft·lb)

26. Turn the driven sprockets clockwise and align "I" marks ④ and ⑤ on the driven sprockets with marks ⑥ and ⑦.

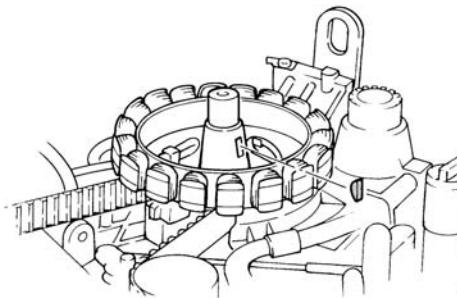


27. Install the timing belt ⑪, turn the belt from the drive sprocket side a half turn counterclockwise to align it, and then remove the pin ⑩.



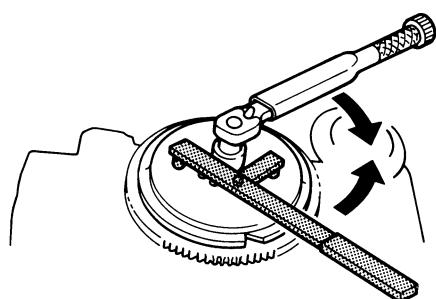
S69J5290

28. Install the Woodruff key.



S69J5300

29. Install the flywheel magnet.



S69J5310

**CAUTION:**

**Apply force in the direction of the arrows shown, to prevent the flywheel holder from slipping off easily.**

**NOTE:**

Apply engine oil to the flywheel magnet nut before installation.

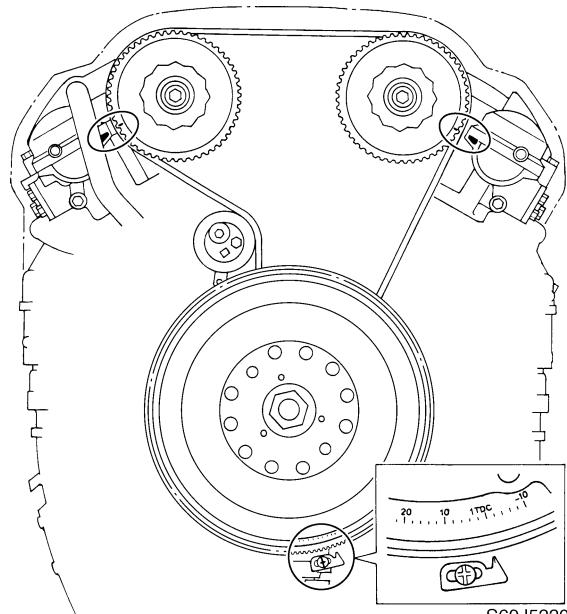


Flywheel magnet holder: YB-06139



Flywheel magnet nut:  
240 N·m (24 kgf·m, 174 ft·lb)

- Turn the flywheel magnet clockwise two turns, and then check that all alignment marks are aligned.



S69J5330

5

**NOTE:**

Do not turn the flywheel magnet counter-clockwise.

- Check each valve clearance and adjust if necessary.
- Install the spark plugs, and then tighten them to the specified torque.
- Install the cylinder head cover bolts, and then tighten them to the specified torques in two stages.



Spark plug:  
25 N·m (2.5 kgf·m, 18 ft·lb)  
Cylinder head cover bolt:  
1st: 8 N·m (0.8 kgf·m, 5.8 ft·lb)  
2nd: 8 N·m (0.8 kgf·m, 5.8 ft·lb)

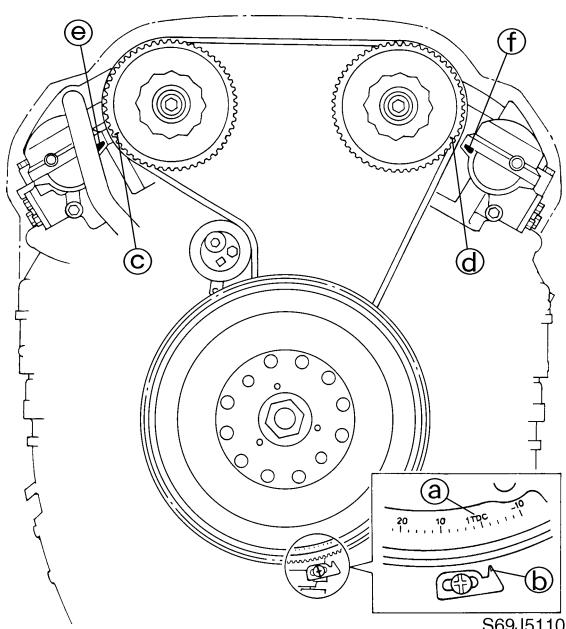
- Install the ignition coil bracket, and connect the ignition coil couplers and spark plug caps.

**POWR****Power unit**

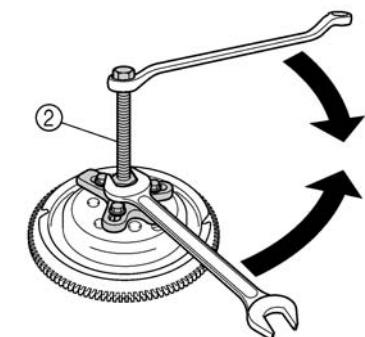
35. Install the ignition coil cover, wiring harness guide, and flywheel magnet cover.

### Replacing the timing belt

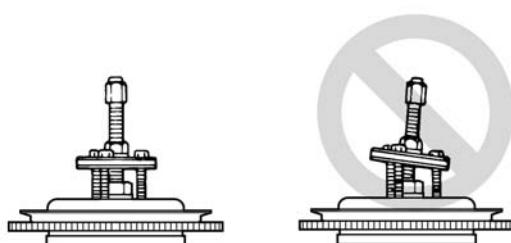
1. Remove the flywheel magnet cover, ignition coil cover, and intake silencer.
2. Turn the flywheel magnet clockwise and align the "1TDC" mark **a** on the flywheel magnet with the pointer **b**, and check that "I" marks **c** and **d** on the driven sprockets are aligned with marks **e** and **f**.



S69J5110



S69J5350



S69J5180

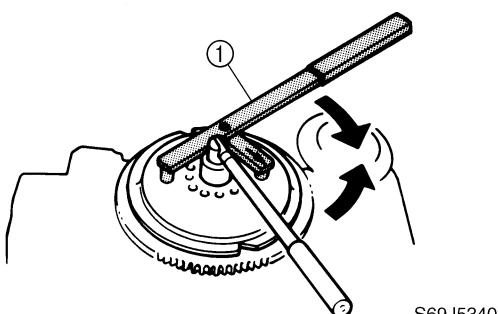
#### **CAUTION:**

- Apply force in the direction of the arrows shown, to prevent the flywheel holder from slipping off easily.
- To prevent damage to the engine or tools, screw in the flywheel puller set bolts evenly and completely so that the flywheel puller plate is parallel to the flywheel magnet.

#### **NOTE:**

Do not turn the flywheel magnet counter-clockwise.

3. Remove the flywheel magnet.



S69J5340



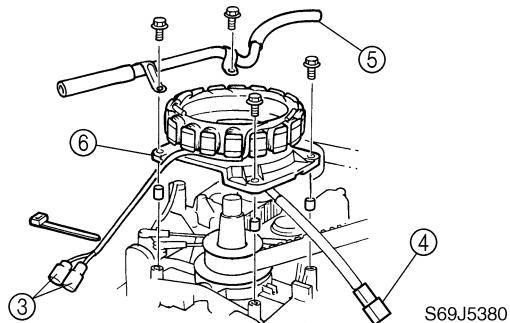
Flywheel magnet holder ①:

YB-06139

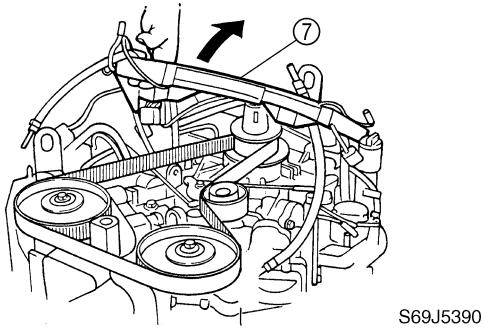
Universal puller ②: YB-06117

4. Disconnect the ignition coil couplers, idle speed control coupler, intake air pressure sensor coupler, throttle position sensor coupler, thermoswitch leads, idle speed control hose, high-pressure fuel hoses, neutral switch coupler, shift cut switch coupler, and starboard fuel injector couplers.

- Disconnect the stator coil couplers ③ and pulser coil coupler ④, and remove the blowby hose ⑤ and stator coil bracket ⑥.



- Remove the wiring harness guide bolts.



**NOTE:**

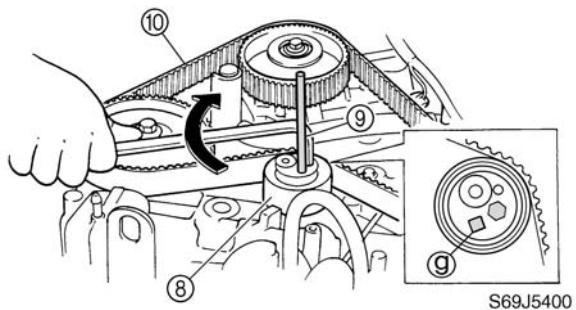
Move the wiring harness guide ⑦ to a position that will make servicing easy.

- Using a hexagon wrench, turn the timing belt tensioner ⑧ clockwise to push the timing belt, increase strength gradually, and then insert a ø5.0 mm (0.2 in) pin ⑨ into the hole ⑩.

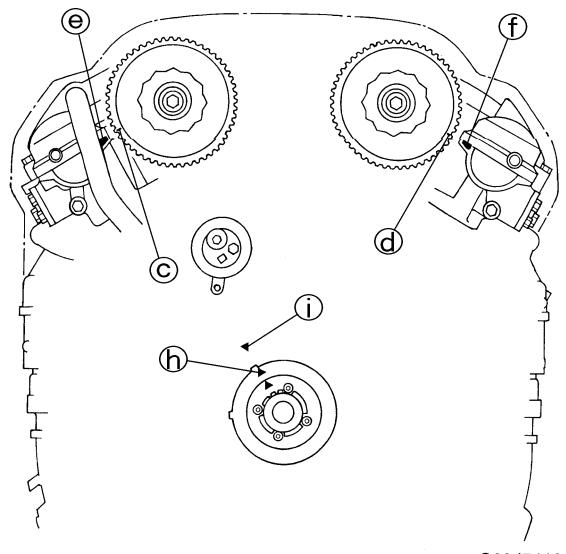
**NOTE:**

Leave the pin inserted into the timing belt tensioner until the timing belt has been installed.

- Remove the timing belt ⑪ from the driven sprocket side.

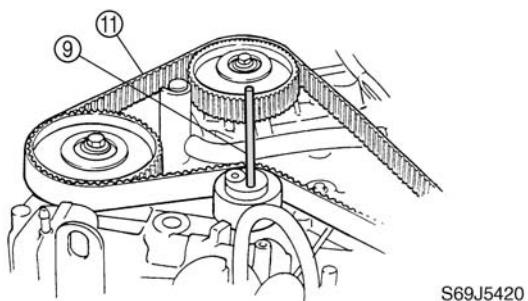


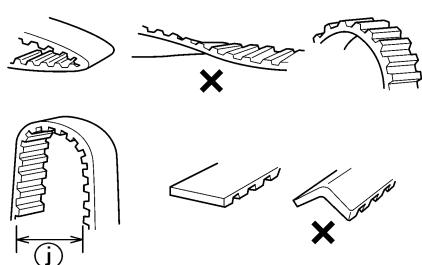
- Check that "I" marks ⑬ and ⑭ on the driven sprockets are aligned with marks ⑮ and ⑯, and that the "▲" mark ⑰ on the plate is aligned with the "▲" mark ⑱ on the cylinder block. Align if necessary.



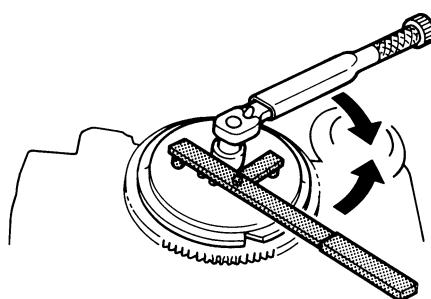
**5**

- Install the timing belt ⑪ from the drive sprocket side with its part number in the upright position, turn the belt a half turn counterclockwise to align it, and then remove the pin ⑨.



**POWR****Power unit**

S69J5430



S69J5310

**CAUTION:**

- Do not twist, turn inside out, or bend the timing belt beyond the maximum limit of 25 mm (1.0 in) ①, otherwise it may be damaged.
- Do not get oil or grease on the timing belt.

11. Turn the drive sprocket clockwise two turns, and then check that all alignment marks are aligned.

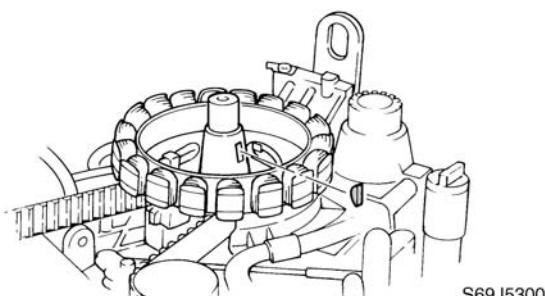
**NOTE:**

Do not turn the drive sprocket counterclockwise.

12. Install the wiring harness guide, stator coil bracket, and blowby hose, and connect the pulser coil coupler and stator coil couplers.

13. Connect all couplers, leads, and hoses.

14. Install the Woodruff key.



S69J5300

15. Install the flywheel magnet.

**CAUTION:**

Apply force in the direction of the arrows shown, to prevent the flywheel holder from slipping off easily.

**NOTE:**

Apply engine oil to the flywheel magnet nut before installation.



Flywheel magnet holder: YB-06139



Flywheel magnet nut:  
240 N·m (24 kgf·m, 174 ft·lb)

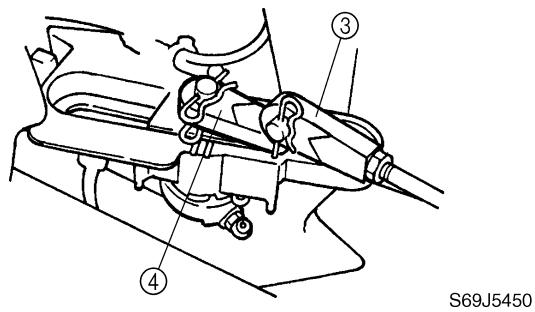
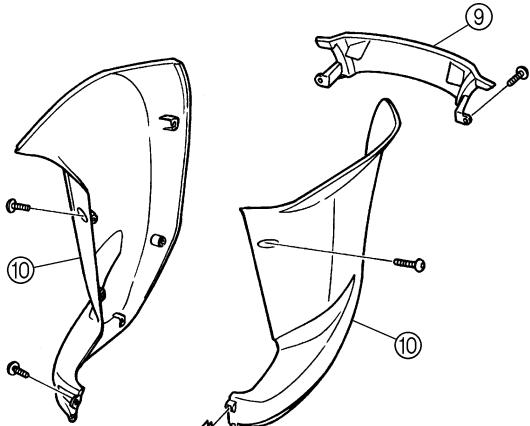
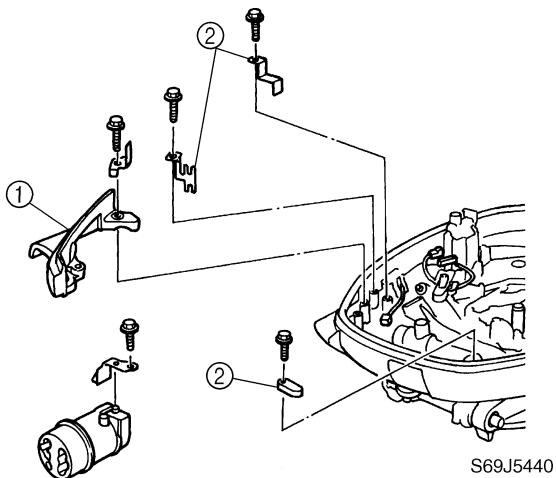
16. Install the intake silencer, ignition coil cover, and flywheel magnet cover.

**Removing the power unit**

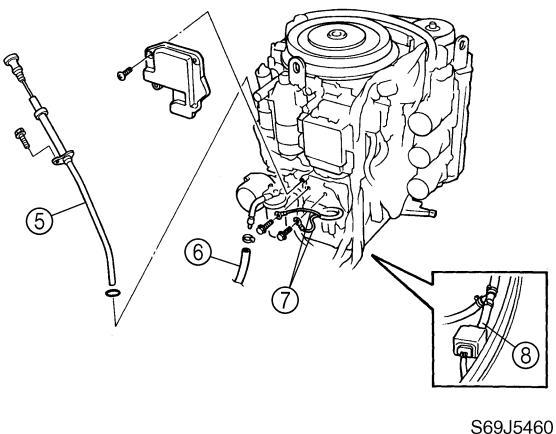
1. Remove the flywheel magnet cover and intake silencer.
2. Remove the retaining plate ① and holders ②, and then disconnect the throttle cable ③ and shift cable ④.

## Power unit

5. Remove the upper case cover ⑨ and aprons ⑩.

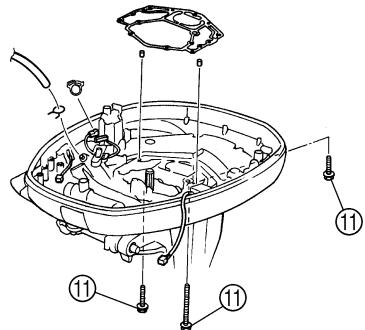
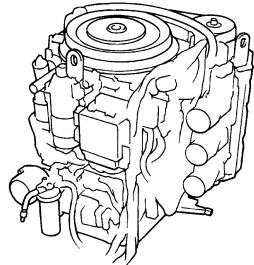


3. Remove the dipstick guide ⑤, and disconnect the fuel hose ⑥, PTT motor leads ⑦, and flushing device hose (flushing device model) ⑧.

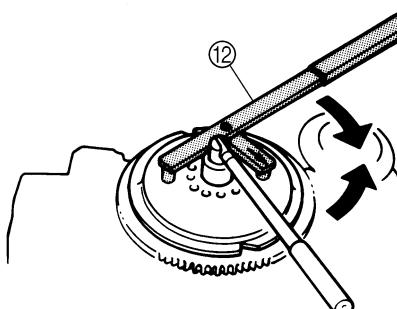


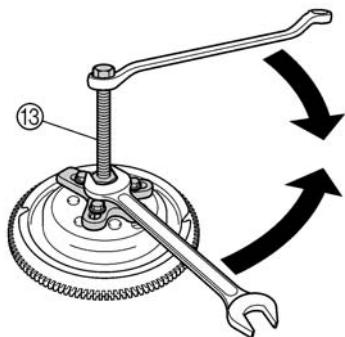
4. Disconnect the fuel pump driver and isolator couplers, PTT switch coupler, shift cut switch coupler, neutral switch coupler, trim sensor coupler, and cooling water pilot hose.

6. Remove the power unit by removing the bolts ⑪.

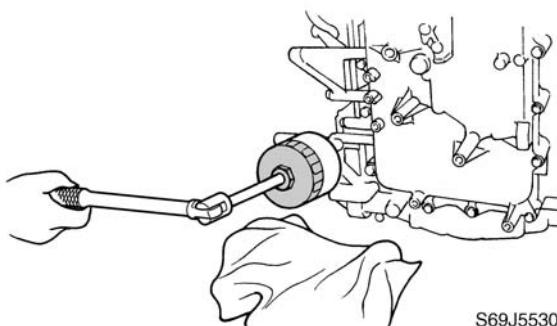


7. Remove the flywheel magnet.

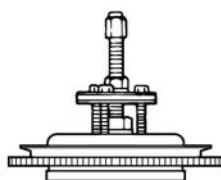


**POWR****Power unit**

S69J5500



S69J5530



S69J5180

**CAUTION:**

- Apply force in the direction of the arrows shown, to prevent the flywheel holder from slipping off easily.
- To prevent damage to the engine or tools, screw in the flywheel puller set bolts evenly and completely so that the flywheel puller plate is parallel to the flywheel magnet.

**NOTE:**

Apply force to the crankshaft end until the flywheel magnet comes off the tapered portion of the crankshaft.



Flywheel magnet holder ⑫:

YB-06139

Universal puller ⑬: YB-06117

**Removing the oil filter**

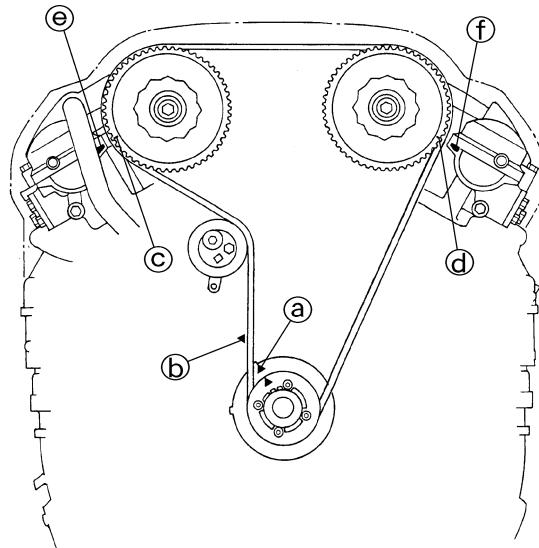
1. Place a rag under the oil filter, and then remove the filter using a 72.5 mm (2.9 in) oil filter wrench.

**NOTE:**

Be sure to clean up any oil spills.

**Removing the timing belt and sprockets**

1. Turn the drive sprocket clockwise and align the “▲” mark ④ on the plate with the “▲” mark ⑤ on the cylinder block, and check that “I” marks ⑥ and ⑦ on the driven sprockets are aligned with marks ⑧ and ⑨.

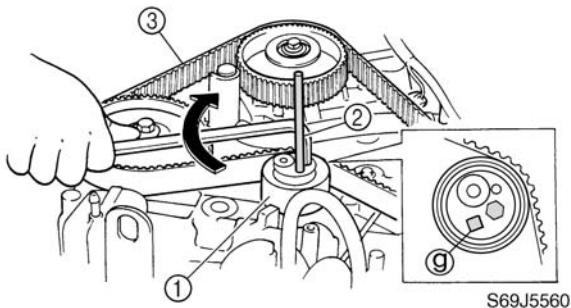


S69J5550

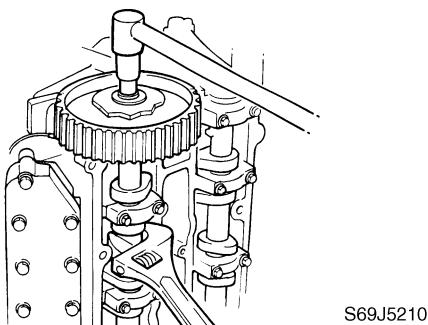
**NOTE:**

Do not turn the drive sprocket counterclockwise.

2. Using a hexagon wrench, turn the timing belt tensioner ① clockwise to push the timing belt, increase strength gradually, and then insert a ø5.0 mm (0.2 in) pin ② into the hole ⑨.
3. Remove the timing belt ③ from the driven sprocket side.



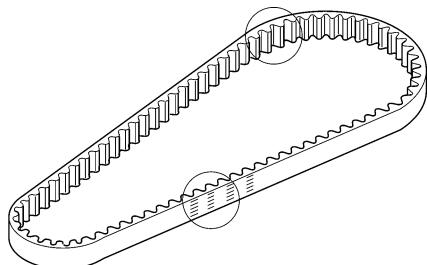
4. Remove the pin and timing belt tensioner.
5. Remove the drive sprocket and plate.
6. Remove the cylinder head covers, and then remove the driven sprockets.



**NOTE:**  
Hold the camshaft with a wrench, and be careful not to damage the driven sprocket.

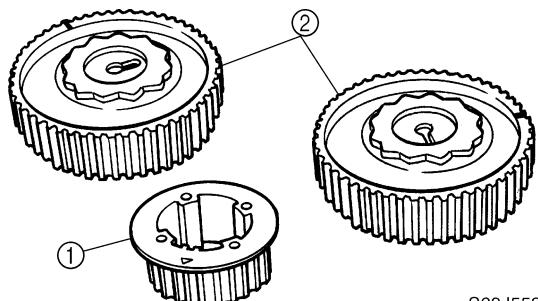
### Checking the timing belt and sprockets

1. Check the interior and exterior of the timing belt for cracks, damage, or wear. Replace if necessary.



S69J5570

2. Check the drive sprocket ① and driven sprockets ② for cracks, damage, or wear. Replace if necessary.

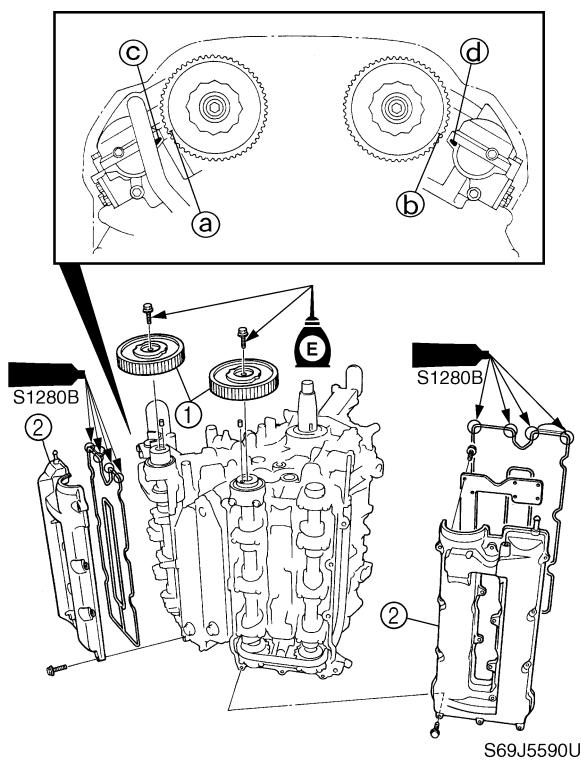


S69J5580



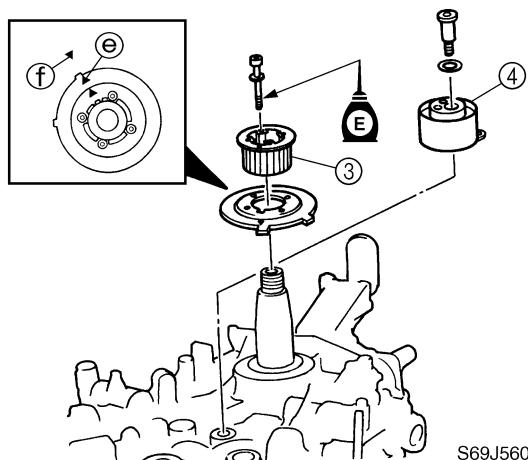
## Installing the sprockets and timing belt

1. Install the driven sprocket ①, and then tighten the bolts to the specified torque.
2. Check that “I” marks ② and ③ on the driven sprocket are aligned with marks ④ and ⑤. Align if necessary.
3. Install the new gaskets, cylinder head cover ⑥, and then tighten the bolts to the specified torques in two stages.



	Driven sprocket bolt: 60 N·m (6.0 kgf·m, 43 ft·lb)
	Cylinder head cover bolt: 1st: 8 N·m (0.8 kgf·m, 5.8 ft·lb) 2nd: 8 N·m (0.8 kgf·m, 5.8 ft·lb)

4. Install the drive sprocket ⑦ and timing belt tensioner ⑧, and then tighten the bolts to the specified torques.
5. Check that the “▲” mark ⑨ on the plate is aligned with the “▲” mark ⑩ on the cylinder block. Align if necessary.



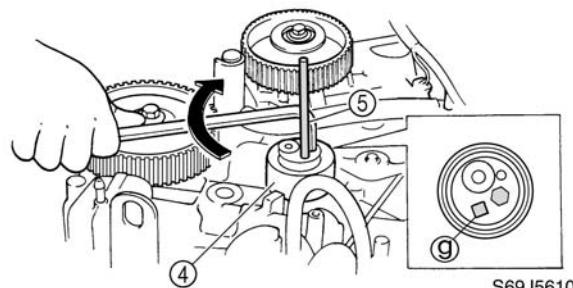
Drive sprocket bolt:

7 N·m (0.7 kgf·m, 5.1 ft·lb)

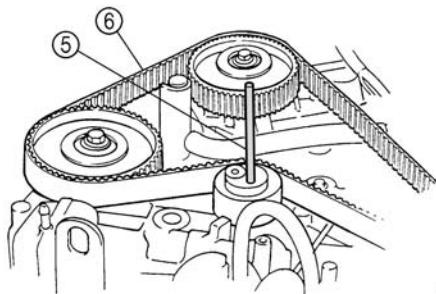
Timing belt tensioner bolt:

39 N·m (3.9 kgf·m, 28 ft·lb)

6. Using a hexagon wrench, turn the timing belt tensioner ⑧ clockwise to push the timing belt, increase strength gradually, and then insert a ø5.0 mm (0.2 in) pin ⑨ into the hole ⑩.

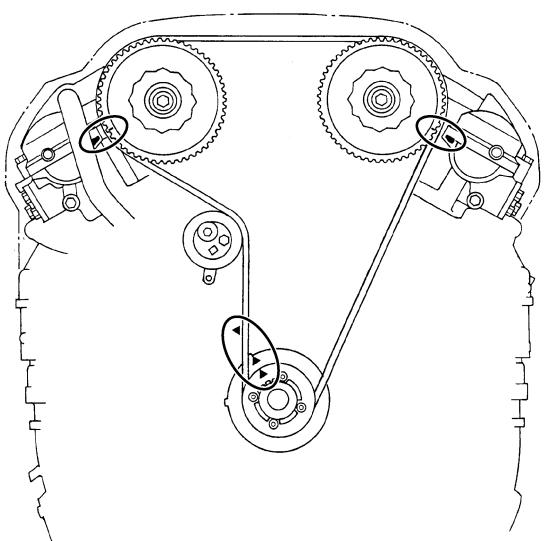


7. Install the timing belt ⑥ from the drive sprocket side with its part number in the upright position, turn the belt a half turn counterclockwise to align it, and then remove the pin ⑤.



S69J5620

8. Turn the drive sprocket clockwise two turns, and then check that the alignment marks are aligned.



S69J5640

**5**

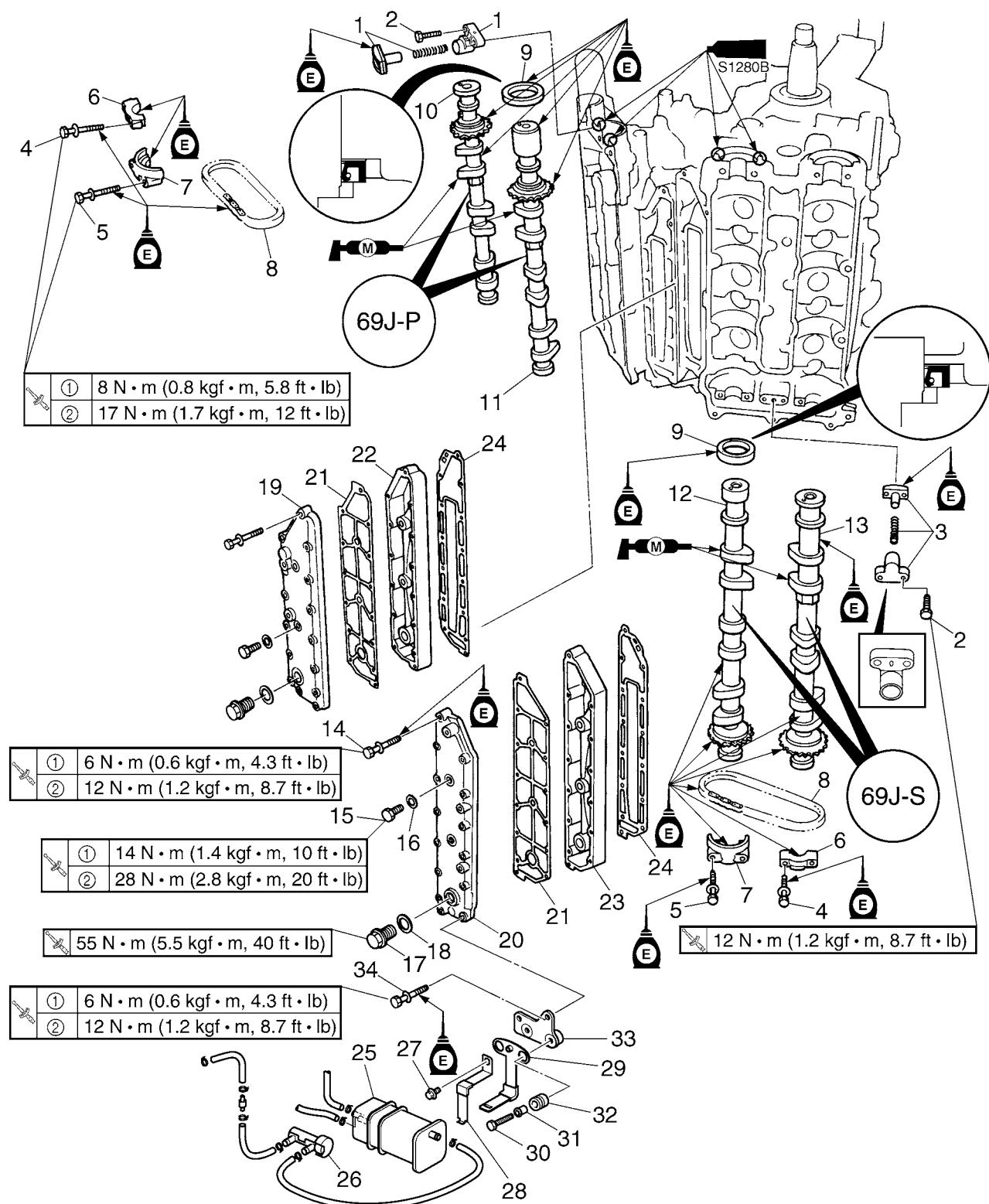
**NOTE:** \_\_\_\_\_  
Do not turn the drive sprocket counterclockwise.

POWR



Power unit

## Cylinder head



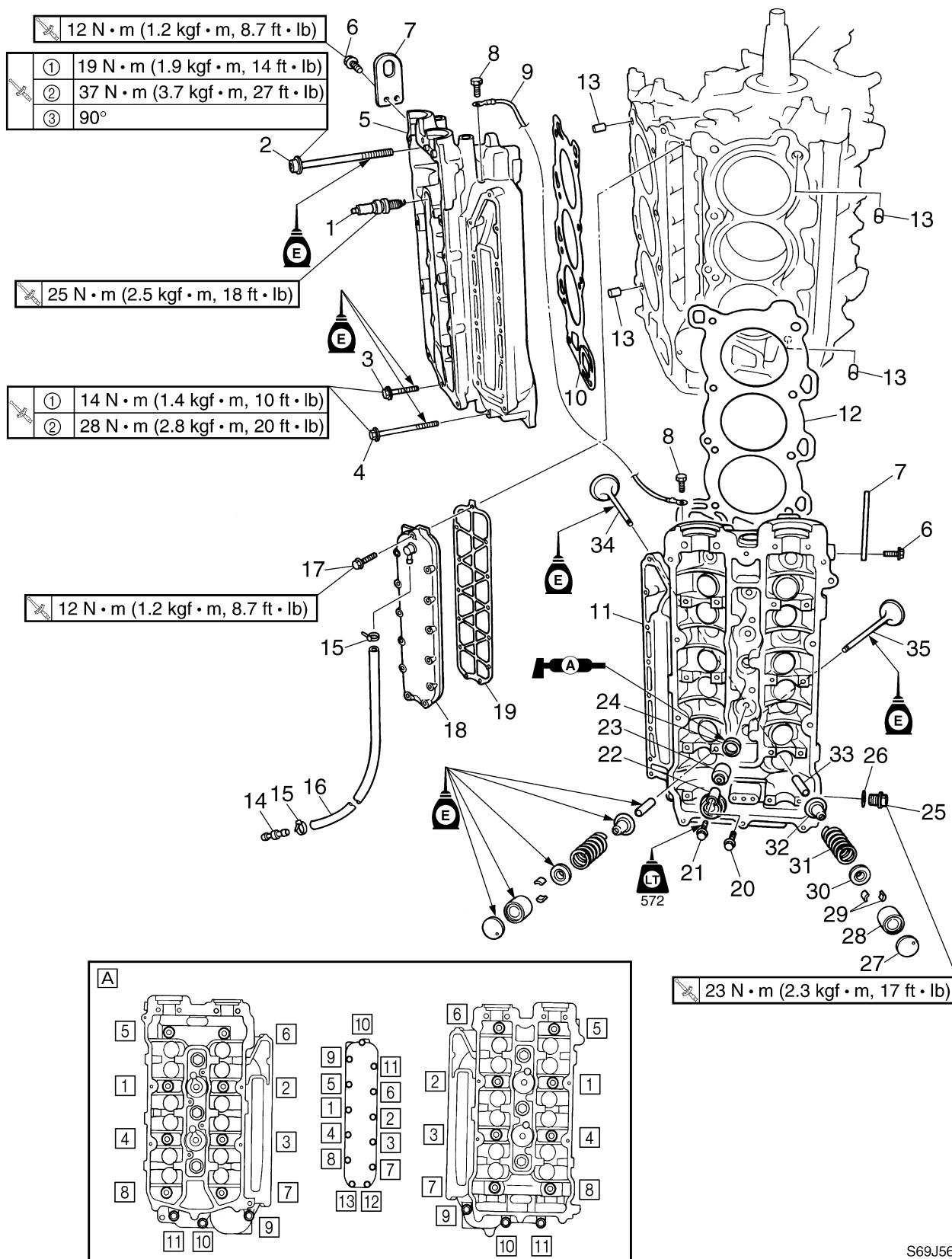
S69J5650U

69J1D11

## Cylinder head

No.	Part name	Q'ty	Remarks
1	Timing chain tensioner	1	
2	Bolt	4	M6 × 25 mm
3	Timing chain tensioner	1	
4	Bolt	32	M7 × 37 mm
5	Bolt	4	M7 × 48 mm
6	Camshaft cap	16	
7	Camshaft cap	2	
8	Timing chain	2	
9	Oil seal	2	<b>Not reusable</b>
10	Camshaft 3	1	
11	Camshaft 4	1	
12	Camshaft 2	1	
13	Camshaft 1	1	
14	Bolt	26	M6 × 50 mm
15	Bolt	4	M8 × 14 mm
16	Gasket	4	<b>Not reusable</b>
17	Plug	2	M18 × 16 mm
18	Gasket	2	<b>Not reusable</b>
19	Port exhaust outer cover	1	
20	Starboard exhaust outer cover	1	
21	Gasket	2	<b>Not reusable</b>
22	Port exhaust inner cover	1	
23	Starboard exhaust inner cover	1	
24	Gasket	2	<b>Not reusable</b>
25	Canister	1	
26	Filter	1	
27	Bolt	1	
28	Holder	1	
29	Bracket	1	
30	Bolt	2	
31	Collar	2	
32	Grommet	2	
33	Bracket	1	
34	Bolt	2	

5

**POWR****Power unit**

S69J5660

## Cylinder head

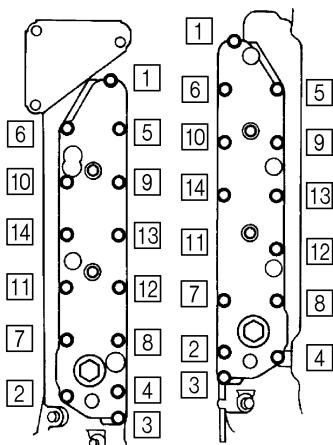
5

No.	Part name	Q'ty	Remarks
1	Spark plug	6	
2	Bolt	16	M10 × 120 mm
3	Bolt	4	M8 × 55 mm
4	Bolt	2	M8 × 90 mm
5	Port cylinder head	1	
6	Bolt	4	M6 × 20 mm
7	Engine hanger	2	
8	Bolt	2	M6 × 12 mm
9	Ground lead	1	
10	Gasket	1	<b>Not reusable</b>
11	Starboard cylinder head	1	
12	Gasket	1	<b>Not reusable</b>
13	Collar	4	
14	Joint	1	
15	Plastic tie	2	<b>Not reusable</b>
16	Cooling water hose	1	
17	Bolt	13	M6 × 30 mm
18	Cooling water passage cover	1	
19	Gasket	1	<b>Not reusable</b>
20	Bolt	4	M8 × 40 mm
21	Bolt	4	
22	Cover	4	
23	Anode	4	
24	Grommet	4	
25	Plug	1	
26	Gasket	1	<b>Not reusable</b>
27	Valve shim	24	
28	Valve lifter	24	
29	Valve cotter	48	
30	Valve spring retainer	24	
31	Valve spring	24	
32	Valve seal	24	<b>Not reusable</b>
33	Valve guide	24	<b>Not reusable</b>
34	Exhaust valve	12	
35	Intake valve	12	

[A] Tightening sequence

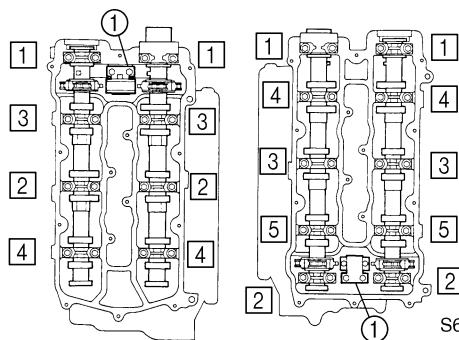
**POWR****Power unit****Removing the cylinder head**

1. Remove the exhaust cover bolts in the sequence shown.



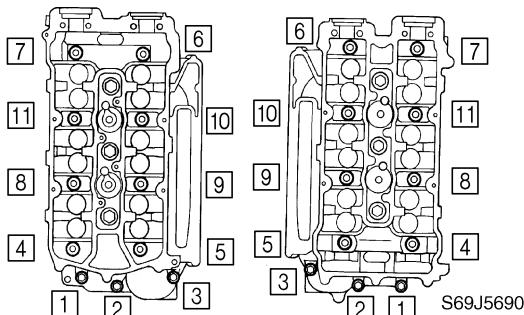
S69J5670

2. Remove the timing chain tensioner ① and camshaft caps in the sequence shown.



S69J5680

3. Remove the camshafts and timing chains, and disconnect the ground lead.
4. Remove the cylinder head bolts in the sequence shown.

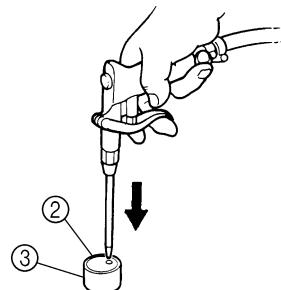


S69J5690

**CAUTION:**

**Do not scratch or damage the mating surfaces of the cylinder head and cylinder block.**

5. Remove the valve shim ② from the valve lifter ③ using compressed air.

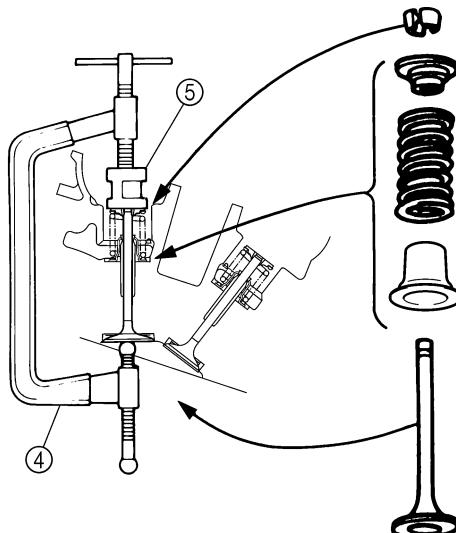


S69J5700

**NOTE:**

**Do not mix the valve train parts. Keep them organized in their proper groups.**

6. Remove the intake valve and exhaust valves.



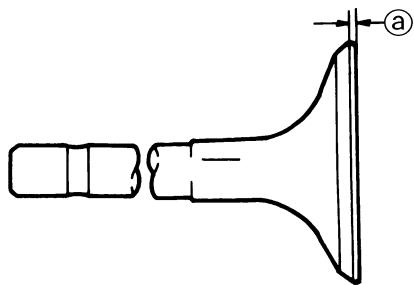
S69J5710

**NOTE:**

**Be sure to keep the valves, springs, and other parts in the order as they were removed.**



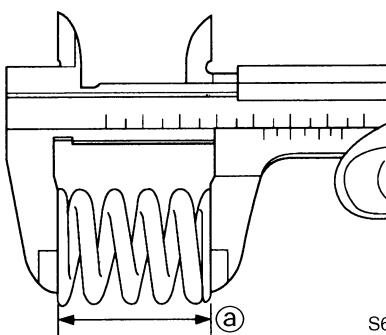
Valve spring compressor ④:  
YM-01253  
Valve spring compressor attachment  
⑤:  
YB-06320



S69J5740

## Checking the valve springs

- Measure the valve spring free length ④.  
Replace if out of specification.

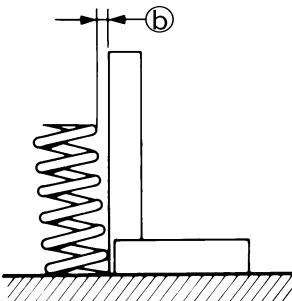


S69J5720



Valve spring free length ④:  
44.20 mm (1.740 in)

- Measure the valve spring tilt ⑤. Replace if out of specification.



S69J5730



Valve spring tilt limit ⑤:  
1.5 mm (0.06 in)

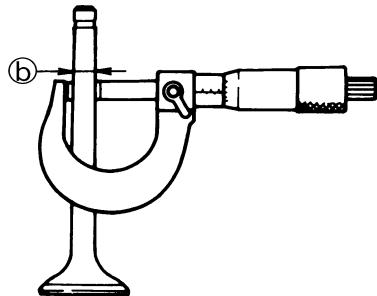
## Checking the valves

- Check the valve face for pitting or wear.  
Replace if necessary.
- Measure the valve margin thickness ⑥.  
Replace if out of specification.



Valve margin thickness ⑥:  
Intake: 0.7 mm (0.028 in)  
Exhaust: 1.0 mm (0.039 in)

- Measure the valve stem diameter ⑦.  
Replace if out of specification.



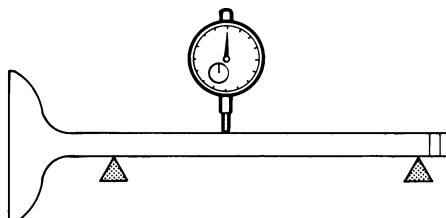
S69J5750

5



Valve stem diameter ⑦:  
Intake:  
5.477–5.492 mm  
(0.2156–0.2162 in)  
Exhaust:  
5.464–5.479 mm  
(0.2151–0.2157 in)

- Measure the valve stem runout. Replace if out of specification.



S69J5760

**POWR****Power unit**

Valve stem runout:

Intake: 0.01 mm (0.0004 in)

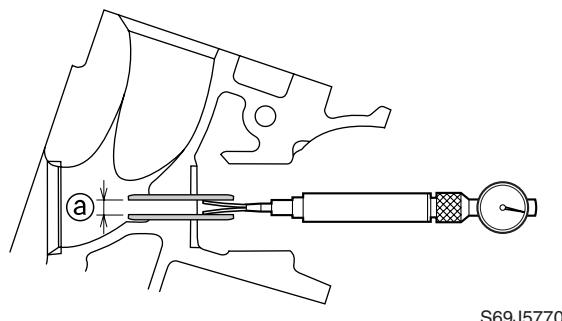
Exhaust: 0.01 mm (0.0004 in)

## Checking the valve guides

### **NOTE:**

Before checking the valve guide make sure that the valve stem diameter is within specification.

1. Measure the valve guide inside diameter ①.



Valve guide inside diameter ①:

5.504–5.522 mm

(0.2167–0.2174 in)

2. Calculate the valve stem-to-valve guide clearance as follows. Replace the valve guide if out of specification.



Valve stem-to-valve guide clearance = valve guide inside diameter – valve stem diameter:

Intake:

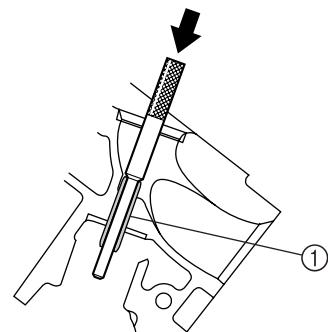
0.025–0.058 mm  
(0.0010–0.0023 in)

Exhaust:

0.025–0.058 mm  
(0.0010–0.0023 in)

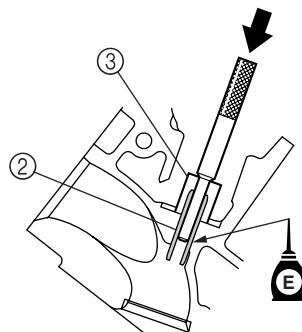
## Replacing the valve guides

1. Remove the valve guide ① by striking the special service tool from the combustion chamber side.



Valve guide remover: YB-06801

2. Install the new valve guide ② by striking the special service tool from the cam-shaft side until the valve guide installer ③ contacts the cylinder head.



### **NOTE:**

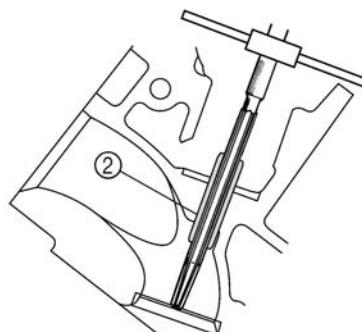
Apply engine oil to the surface of the new valve guide.



Valve guide remover: YB-06801

Valve guide installer: YB-06810

3. Insert the special service tool into the valve guide ②, and then ream the valve guide.

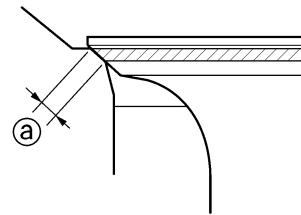


**NOTE:**

- Turn the valve guide reamer clockwise to ream the valve guide.
- Do not turn the reamer counterclockwise when removing the reamer.



Valve guide reamer: YB-06804

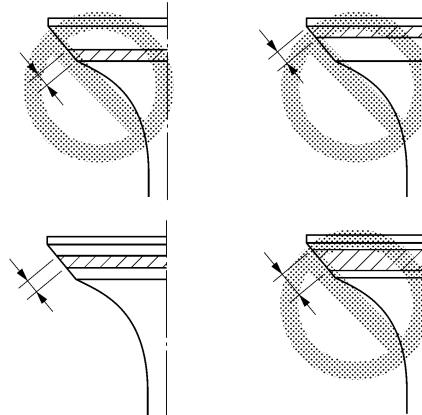


S69J5830

4. Measure the valve guide inside diameter. Replace the valve guide if out of specification.



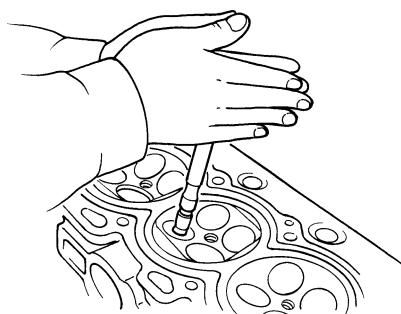
Valve guide inside diameter:  
5.51–5.52 mm (0.2169–0.2173 in)



S69J5840

## Checking the valve seat

1. Eliminate carbon deposits from the valve with a scraper.
2. Apply a thin, even layer of Mechanic's blueing dye (Dykem) onto the valve seat.
3. Lap the valve slowly on the valve seat with a valve lapper (commercially obtainable) as shown.



S69J5820

4. Measure the valve seat contact width **a** where the blueing dye is adhered to the valve face. Reface the valve seat if the valve is not seated properly or if the valve seat contact width is out of specification. Replace the valve guide if the valve seat contact is uneven.

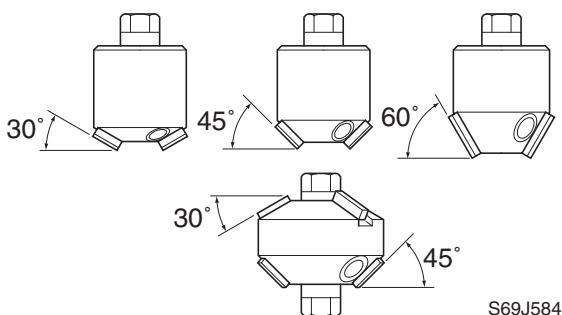


Valve seat contact width **a**:  
Intake:  
1.1–1.4 mm (0.043–0.055 in)  
Exhaust:  
1.4–1.7 mm (0.055–0.067 in)

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## Refacing the valve seat

1. Reface the valve seat with the valve seat cutter.



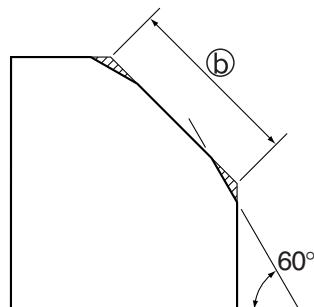
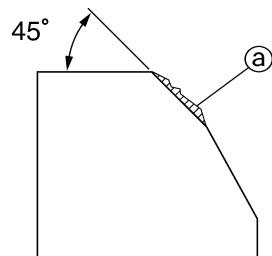
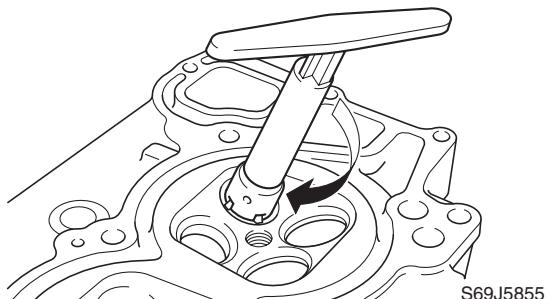
S69J5845



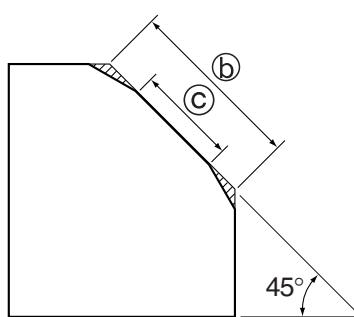
Valve seat cutter set: YB-91044

**POWR****Power unit**

2. Cut the surface of the valve seat with a  $45^\circ$  cutter by turning the cutter clockwise until the valve seat face has become smooth.

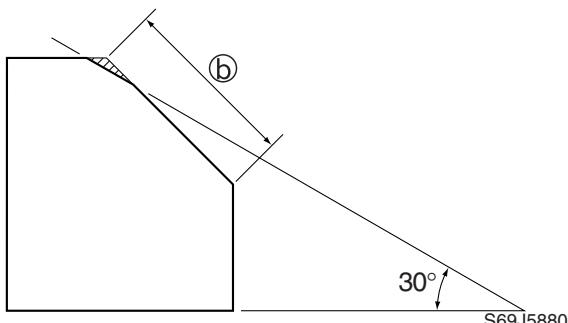


5. Use a  $45^\circ$  cutter to adjust the contact width of the valve seat to specification.

**CAUTION:**

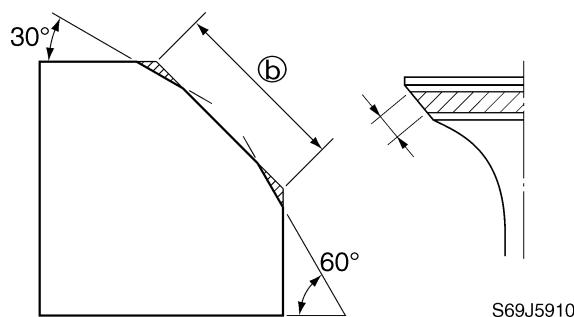
**Do not over cut the valve seat. Be sure to turn the cutter evenly downward at a pressure of 40–50 N (4–5 kgf, 8.8–11 lbf) to prevent chatter marks.**

3. Use a  $30^\circ$  cutter to adjust the contact width of the top edge of the valve seat.



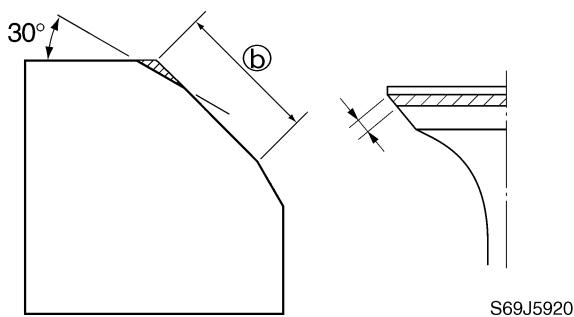
4. Use a  $60^\circ$  cutter to adjust the contact width of the bottom edge of the valve seat.

6. If the valve seat contact area is too wide and situated in the center of the valve face, use a  $30^\circ$  cutter to cut the top edge of the valve seat, a  $60^\circ$  cutter to cut the bottom edge to center the area and set its width.



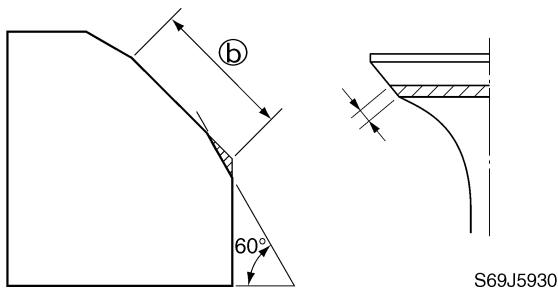
7. If the valve seat contact area is too narrow and situated near the top edge of the valve face, use a  $30^\circ$  cutter to cut the top edge of the valve seat. If necessary, use a  $45^\circ$  cutter to center the area and set its width.

## Cylinder head



(b) Previous contact width

- If the valve seat contact area is too narrow and situated near the bottom edge of the valve face, use a  $60^\circ$  cutter to cut the bottom edge of the valve seat. If necessary, use a  $45^\circ$  cutter to center the area and set its width.



(b) Previous contact width

- Apply a thin, even layer of lapping compound onto the valve seat, and then lap the valve using a valve lapper (commercially obtainable).



S69J5820

### CAUTION:

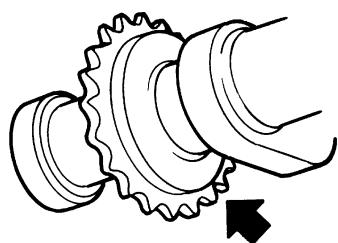
**Do not get the lapping compound on the valve stem and valve guide.**

- After every lapping procedure, be sure to clean off any remaining lapping compound from the cylinder head and the valve.

- Check the valve seat contact area of the valve again.

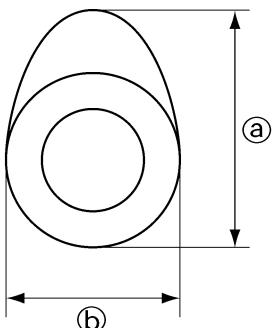
### Checking the camshaft

- Check the timing chain sprockets for damage or wear. Replace the camshaft if necessary.



S69J5940

- Measure the cam lobe. Replace if out of specification.



S69J5950



#### Cam lobe @:

Intake:  
45.30–45.40 mm  
(1.7835–1.7874 in)

Exhaust:  
45.35–45.45 mm  
(1.7854–1.7894 in)

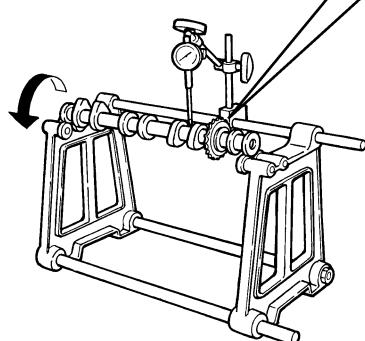
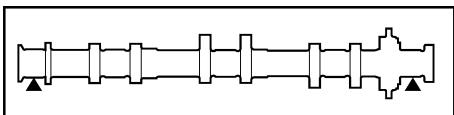
#### Cam lobe b:

Intake:  
35.95–36.05 mm  
(1.4154–1.4193 in)

Exhaust:  
35.95–36.05 mm  
(1.4154–1.4193 in)

**POWR****Power unit**

- Measure the camshaft runout. Replace if out of specification.

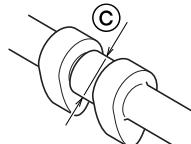


S69J5960



**Camshaft runout limit:**  
0.03 mm (0.0012 in)

- Measure the camshaft journal diameter  $\textcircled{C}$  and cylinder head journal inside diameter  $\textcircled{d}$ . Replace the camshaft and cylinder head if out of specification.



S69J5970



**Camshaft journal diameter  $\textcircled{C}$ :**  
24.96–24.98 mm  
(0.9827–0.9834 in)  
**Camshaft cap inside diameter  $\textcircled{d}$ :**  
25.00–25.02 mm  
(0.9843–0.9850 in)

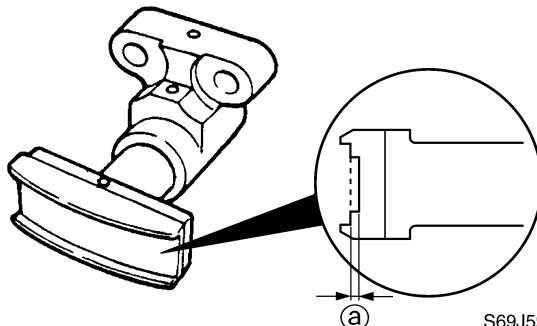
- Calculate the camshaft oil clearance  $\textcircled{e}$  as follows. Replace the camshaft and cylinder head as a set if out of specification.



**Camshaft oil clearance  $\textcircled{e}$  =**  
Camshaft cap inside diameter  $\textcircled{d}$  –  
Camshaft journal diameter  $\textcircled{C}$ :  
0.02–0.06 mm (0.0008–0.0023 in)

**Checking the timing chain tensioner**

- Measure the plunger extended length  $\textcircled{a}$ . Replace if out of specification.



S69J5980

**NOTE:**

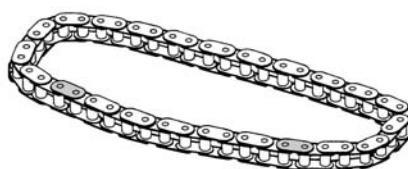
Check the timing chain tensioner every 400 hours of operation.



**Timing chain tensioner wear limit  $\textcircled{a}$ :**  
1.0 mm (0.04 in) from standard

**Checking the timing chain**

- Check the timing chain for damage or wear. Replace if necessary.

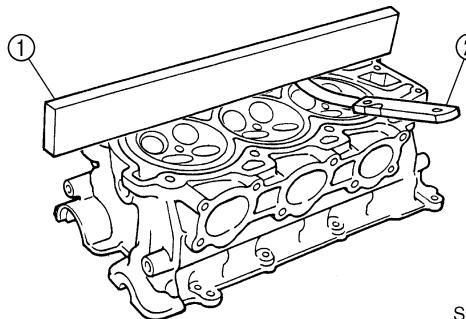


S69J5990

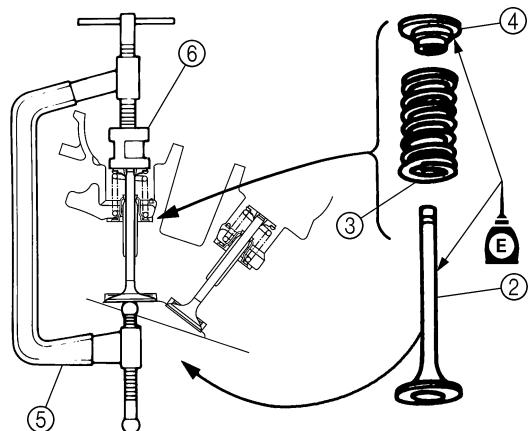
**Checking the cylinder head**

- Eliminate carbon deposits from the combustion chambers and check for deterioration.

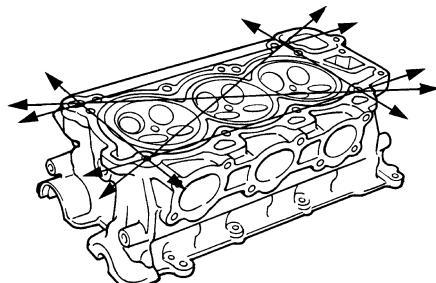
2. Check the cylinder head warpage using a straightedge ① and thickness gauge ② in six directions as shown. Replace if out of specification.



S69J5A00



S69J5A30



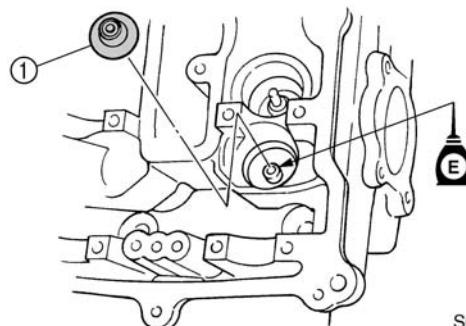
S69J5A10



Cylinder head warpage limit:  
0.1 mm (0.004 in)

### Installing the valves

1. Install the new valve seal ① to the valve guide.



S69J5A20

2. Install the valve ②, valve spring ③, and valve spring retainer ④ in the sequence shown, and then attach the special service tool.

**NOTE:** \_\_\_\_\_  
The valve spring can be installed in any direction.



Valve spring compressor ⑤:  
YM-01253

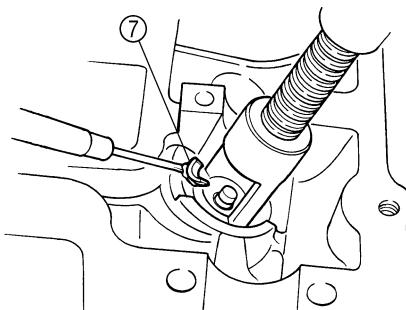
Valve spring compressor attachment

⑥:

YB-06320

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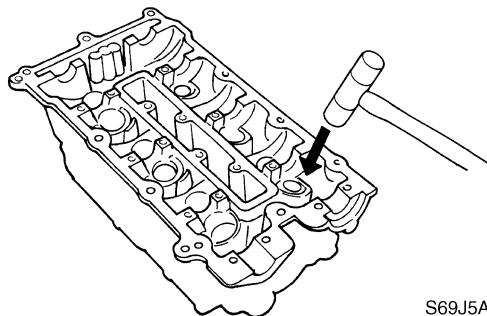
3. Compress the valve spring, and then install the valve cotter ⑦ using a thin screwdriver with a small amount of grease applied to it.



S69J5A40



4. Lightly tap the valve spring retainer with a plastic hammer to set the valve cotter securely.



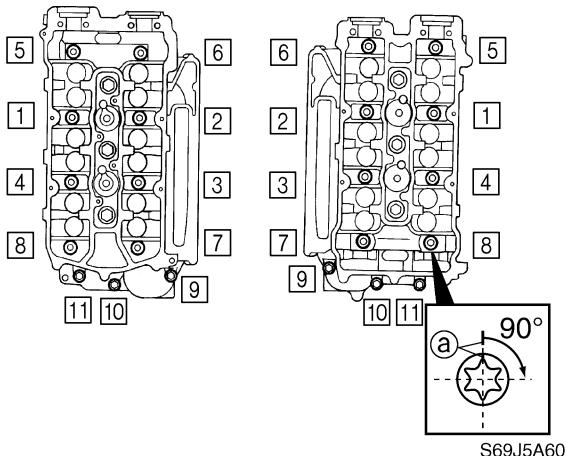
S69J5A50

**NOTE:**

Apply engine oil to the valve shims and valve lifters before installation.

**Installing the cylinder head**

1. Install the new gaskets and cylinder heads, and then tighten the bolts to the specified torques in the sequence shown.



S69J5A60

**CAUTION:**

**Do not reuse the cylinder head gaskets, always replace them with new ones.**

**NOTE:**

- Apply engine oil to the cylinder head bolts before installation.
- Tighten the M10 bolts to the specified torques in three stages first, and then tighten the M8 bolts to the specified torques in two stages.
- Make a mark **a** on the M10 bolts and the cylinder head, and then tighten the bolts 90° from the mark.

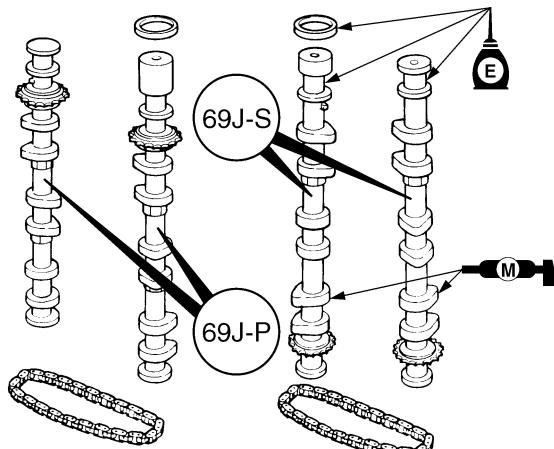
**Cylinder head bolt (M10):**

- 1st: 19 N·m (1.9 kgf·m, 14 ft·lb)  
2nd: 37 N·m (3.7 kgf·m, 27 ft·lb)  
3rd: 90°

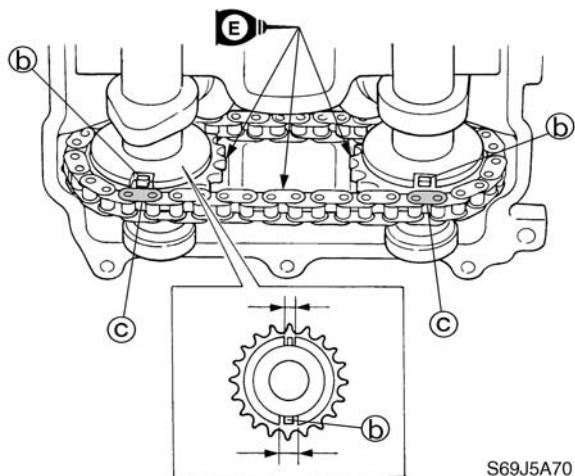
**Cylinder head bolt (M8):**

- 1st: 14 N·m (1.4 kgf·m, 10 ft·lb)  
2nd: 28 N·m (2.8 kgf·m, 20 ft·lb)

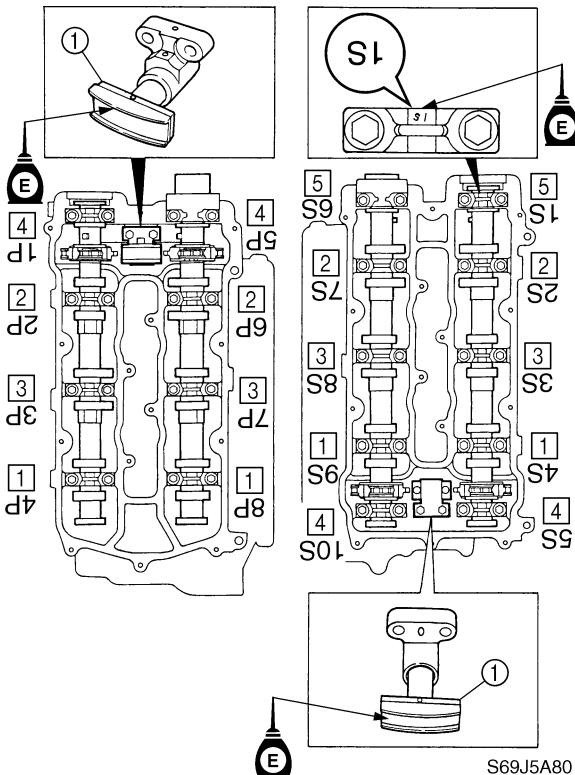
2. Connect the ground lead.
3. Align the projection (wide one) **b** on the camshaft sprockets to the alignment plate (gold) **c** on the timing chain, and then install the camshafts to the cylinder head with new oil seals.



S69J5240



4. Install the camshaft caps, and then tighten the bolts to the specified torques in two stages and in the sequence shown.
5. Install the timing chain tensioners ①, and then tighten the bolts to the specified torque in the sequence shown.



### NOTE:

- Install the camshaft caps in the proper position as shown and with the stamped numbers facing upside down.
- Apply engine oil to the camshaft cap bolts before installation.



**Camshaft cap bolt:**

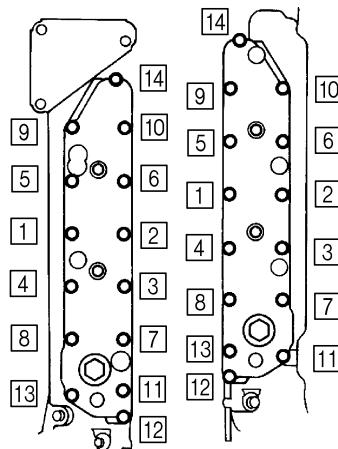
1st: 8 N·m (0.8 kgf·m, 5.8 ft·lb)

2nd: 17 N·m (1.7 kgf·m, 12 ft·lb)

**Timing chain tensioner bolt:**

12 N·m (1.2 kgf·m, 8.7 ft·lb)

6. Install the new gaskets, exhaust covers and canister bracket, and then tighten the bolts to the specified torques in two stages and in the sequence shown.



S69J5A90

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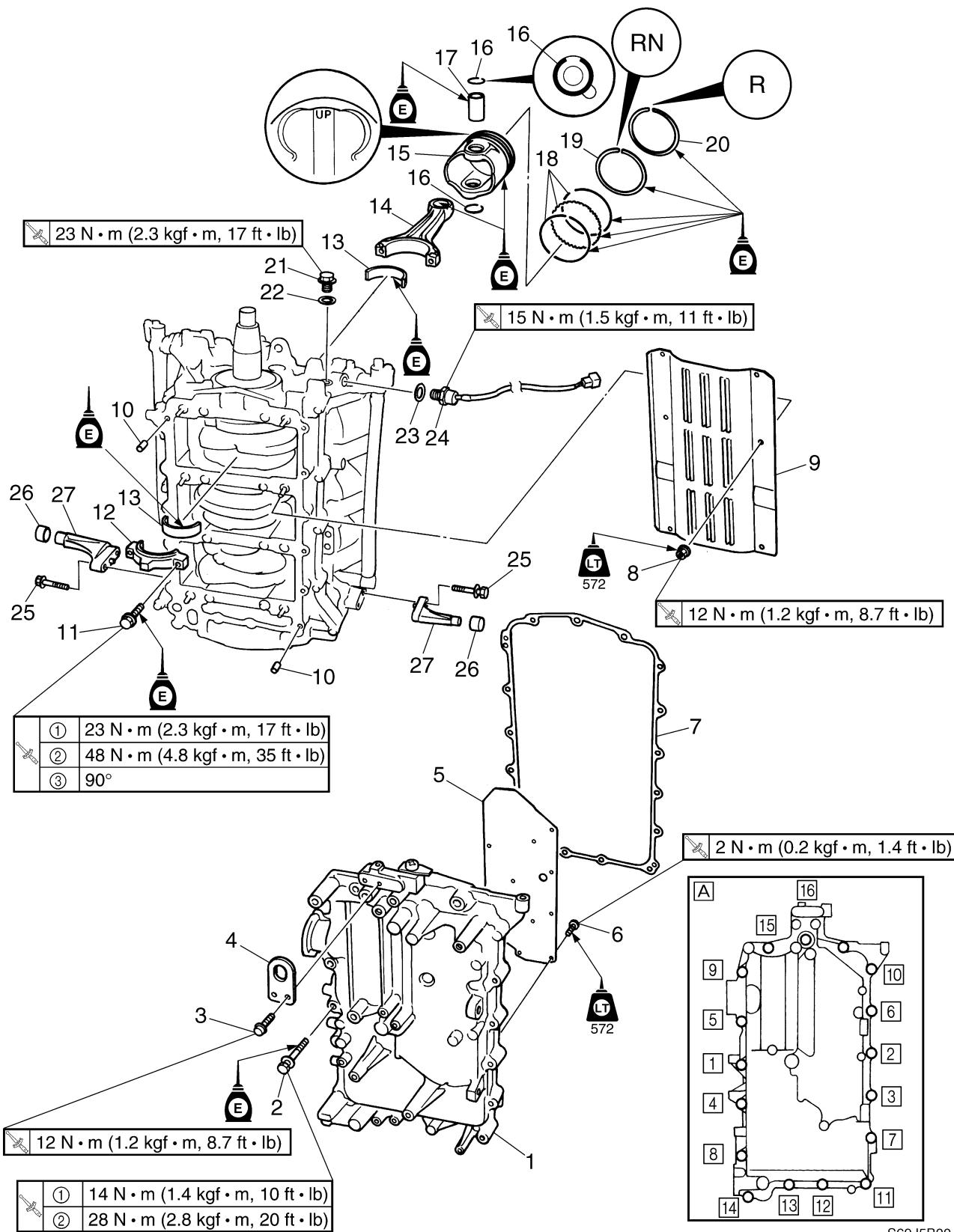
**Exhaust cover bolt:**

1st: 6 N·m (0.6 kgf·m, 4.3 ft·lb)

2nd: 12 N·m (1.2 kgf·m, 8.7 ft·lb)



# Cylinder block



S69J5B00

## Cylinder block

No.	Part name	Q'ty	Remarks
1	Crankcase cover	1	
2	Bolt	17	M8 × 45 mm
3	Bolt	2	M6 × 20 mm
4	Engine hanger	1	
5	Plate	1	
6	Screw	14	M4 × 8 mm
7	Gasket	1	Not reusable
8	Nut	6	
9	Baffle plate	1	
10	Dowel pin	2	
11	Bolt	12	Not reusable
12	Connecting rod cap	6	
13	Connecting rod bearing	12	
14	Connecting rod	6	
15	Piston	6	
16	Clip	12	Not reusable
17	Piston pin	6	
18	Oil ring	6	
19	2nd piston ring	6	
20	Top ring	6	
21	Plug	1	
22	Gasket	1	Not reusable
23	Gasket	1	Not reusable
24	Engine temperature sensor	1	
25	Bolt	4	M6 × 25 mm
26	Cap	2	
27	Stopper	2	

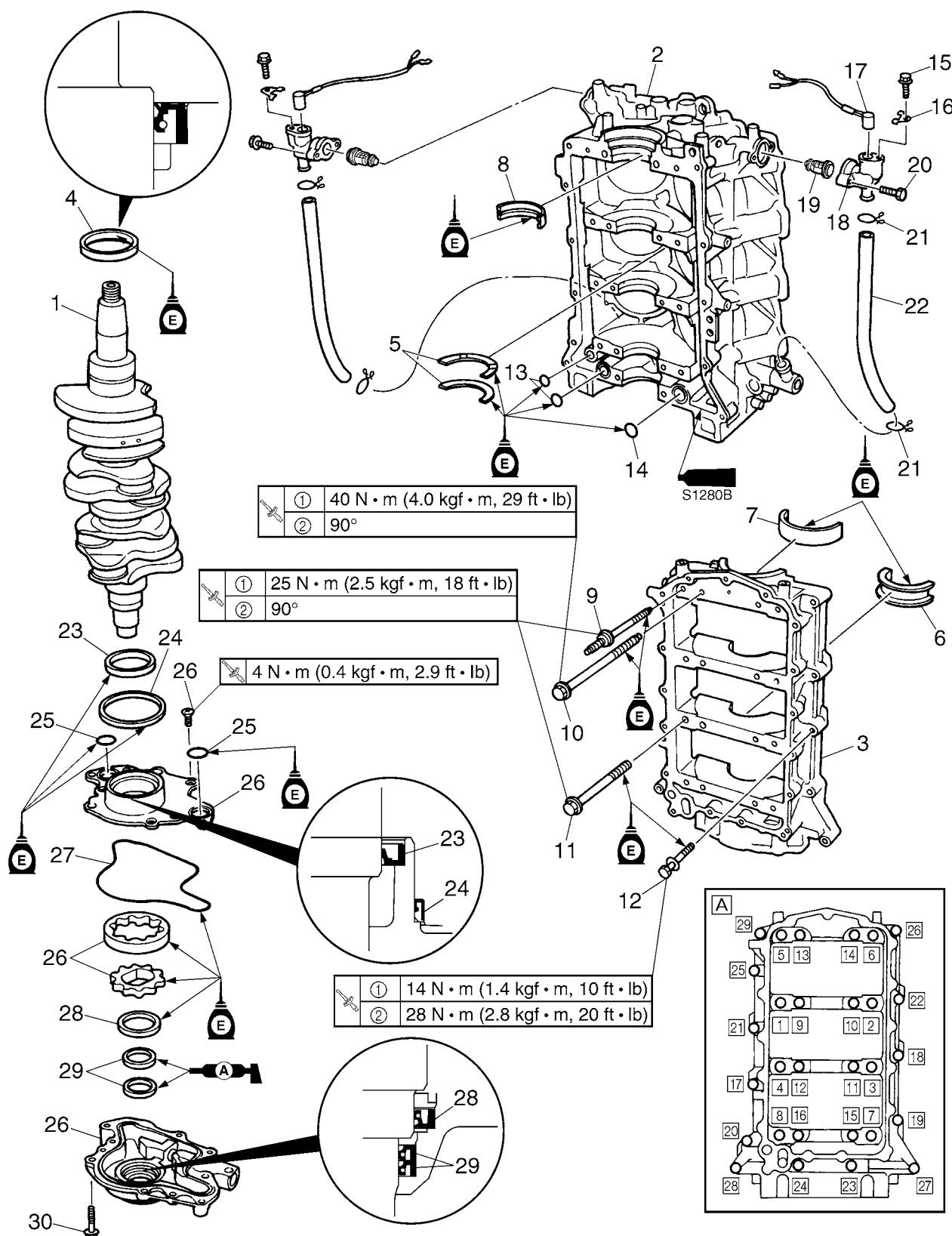
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[A] Tightening sequence

POWR



Power unit



S69J5B10U

## Cylinder block

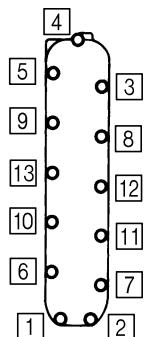
No.	Part name	Q'ty	Remarks
1	Crankshaft	1	
2	Cylinder block	1	
3	Crankcase	1	
4	Oil seal	1	<b>Not reusable</b>
5	Thrust bearing	2	
6	Thrust bearing	1	
7	Main bearing	4	
8	Main bearing	4	
9	Stud bolt	6	M8 × 95 mm
10	Bolt	8	M10 × 105 mm
11	Bolt	2	M8 × 95 mm
12	Bolt	13	M8 × 55 mm
13	O-ring	2	<b>Not reusable</b> 1.9 × 22.9 mm
14	O-ring	1	<b>Not reusable</b>
15	Bolt	2	M6 × 20 mm
16	Holder	2	
17	Thermoswitch	2	
18	Cover	2	
19	Thermostat	2	
20	Bolt	4	M6 × 25 mm
21	Clip	4	
22	Cooling water hose	2	
23	Oil seal	1	<b>Not reusable</b>
24	Oil seal	1	<b>Not reusable</b>
25	O-ring	2	<b>Not reusable</b>
26	Oil pump assembly	1	
27	Gasket	1	<b>Not reusable</b>
28	Oil seal	1	<b>Not reusable</b>
29	Oil seal	2	<b>Not reusable</b>
30	Bolt	4	M6 × 40 mm

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[A] Tightening sequence

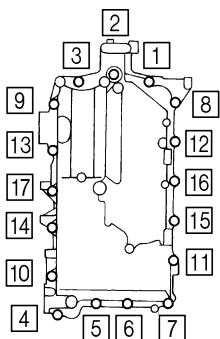
**POWR****Power unit****Disassembling the cylinder block**

1. Remove the cooling water passage cover bolts in the sequence shown.



S69J5B20

2. Remove the crankcase cover bolts in the sequence shown.

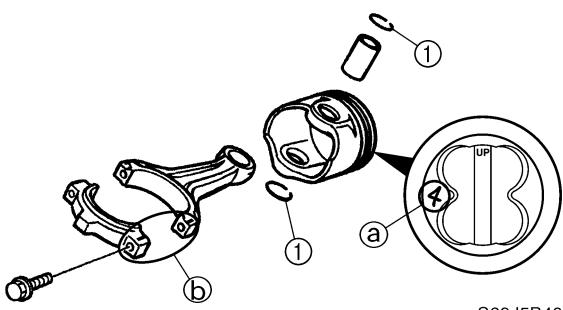


S69J5B30

**NOTE:**

Do not remove the ignition timing pointer from the crankcase cover.

3. Remove the baffle plate.
4. Remove the connecting rod bolts and the connecting rod caps, and then remove the connecting rod and piston assemblies.
5. Remove the clips ① with pliers, and then remove the piston.

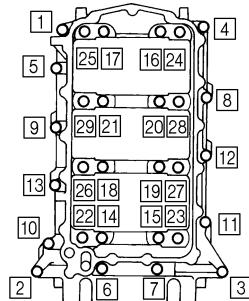


S69J5B40

**NOTE:**

- Be sure to keep the bearings in the order as they were removed, and to note the bearing color.
- Mark each piston with an identification number ③ of the corresponding cylinder. Also, mark each connecting rod and connecting rod cap on the up side (flywheel side) with an identification mark ④.
- Do not mix the connecting rods and caps. Keep them organized in their proper groups.

6. Remove the crankcase bolts in the sequence shown.

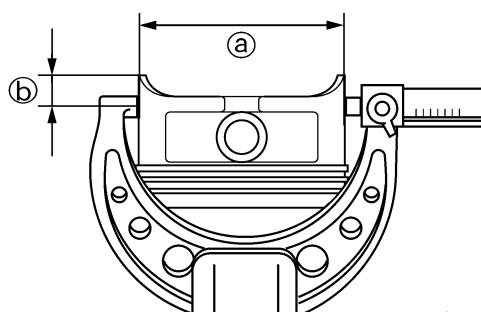


S69J5B50

7. Remove the oil pump, then the crankshaft.

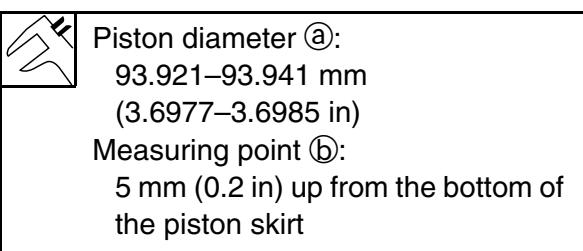
**Checking the piston diameter**

1. Measure the piston outside diameter at the specified measuring point. Replace if out of specification.



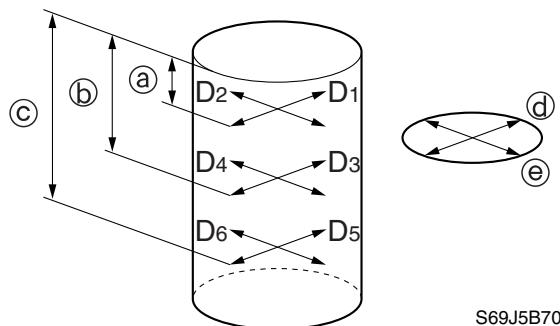
S69J5B60

# Cylinder block



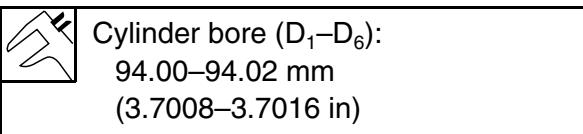
## Checking the cylinder bore

- Measure the cylinder bore ( $D_1$ – $D_6$ ) at measuring points ①, ②, and ③, and in direction ④ ( $D_1$ ,  $D_3$ ,  $D_5$ ), which is parallel to the crankshaft, and direction ⑤ ( $D_2$ ,  $D_4$ ,  $D_6$ ), which is at a right angle to the crankshaft.

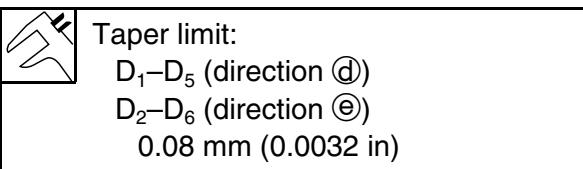


S69J5B70

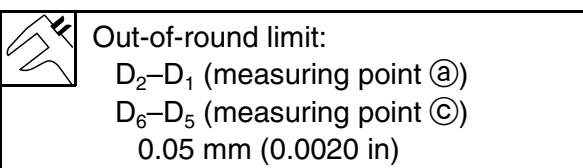
- ① 20 mm (0.8 in)
- ② 60 mm (2.4 in)
- ③ 100 mm (3.9 in)



- Calculate the taper limit. Replace or reboore the cylinder block if out of specification.

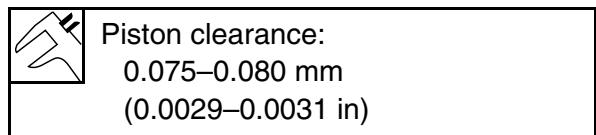


- Calculate the out-of-round limit. Replace or reboore the cylinder block if out of specification.



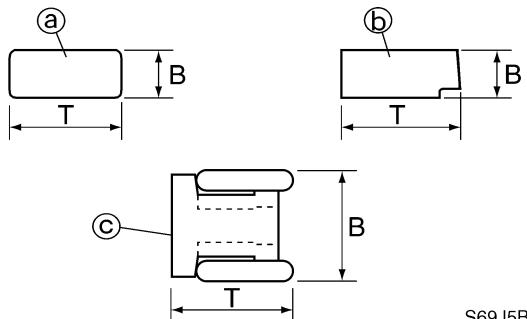
## Checking the piston clearance

- Rebore the cylinder or replace the piston and piston rings as a set, or the cylinder block, or all parts if out of specification.



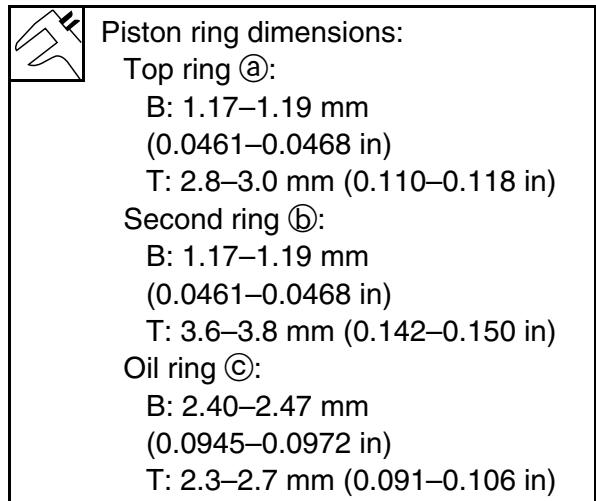
## Checking the piston rings

- Check the piston ring dimensions of B and T. Replace if out of specification.

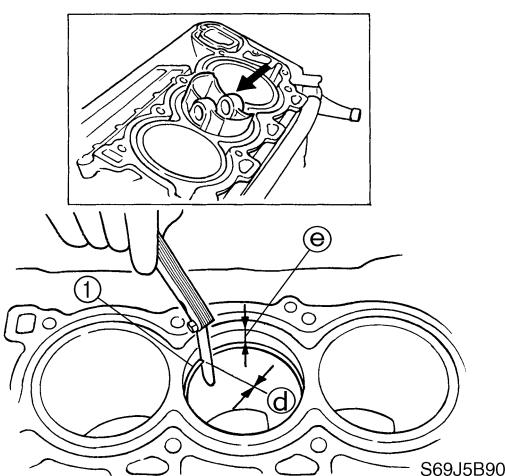


S69J5B80

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- Level the piston ring ① in the cylinder with a piston crown.
- Check the piston ring end gap ② at the specified measuring point. Replace if out of specification.



S69J5B90

**Piston ring end gap ④:**

Top ring:

0.15–0.30 mm  
(0.0059–0.0118 in)

Second ring:

0.30–0.45 mm  
(0.0118–0.0177 in)

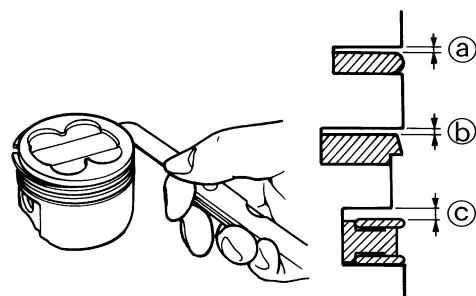
Oil ring:

0.15–0.60 mm  
(0.0059–0.0236 in)

Measuring point ⑤: 20 mm (0.8 in)

**Checking the piston ring side clearance**

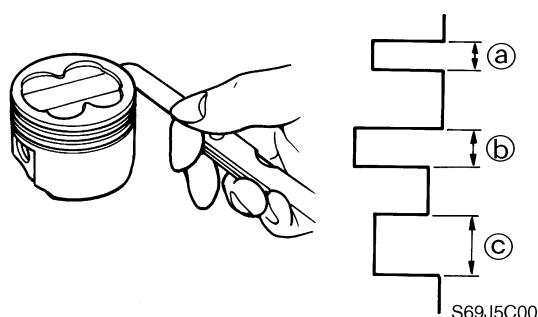
- Measure the piston ring side clearance. Replace the piston and piston rings as a set if out of specification.



S69J5C10

**Piston ring side clearance:**Top ring ⑥:  
0.04–0.08 mm  
(0.0016–0.0031 in)Second ring ⑦:  
0.03–0.07 mm  
(0.0012–0.0027 in)Oil ring ⑧:  
0.04–0.13 mm  
(0.0016–0.0051 in)**Checking the piston ring grooves**

- Measure the piston ring grooves. Replace the piston if out of specification.



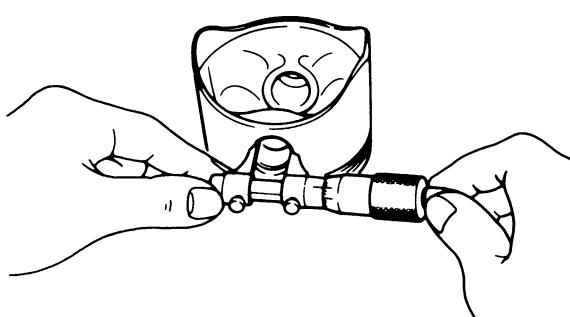
S69J5C00

**Piston ring groove:**

Top ring ⑨:	1.23–1.25 mm (0.048–0.049 in)
Second ring ⑩:	1.22–1.24 mm (0.048–0.049 in)
Oil ring ⑪:	2.51–2.53 mm (0.099–0.100 in)

**Checking the piston pin boss bore**

- Measure the piston pin boss bore. Replace the piston if out of specification.



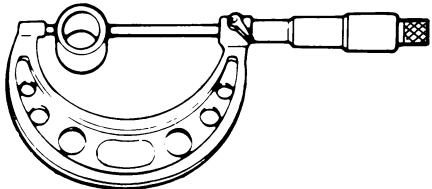
S69J5C20



Piston pin boss bore:	21.02–21.03 mm (0.8276–0.8280 in)
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### Checking the piston pin

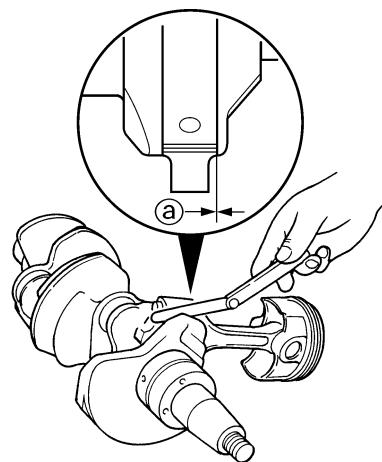
- Measure the piston pin diameter. Replace if out of specification.



S69J5C30



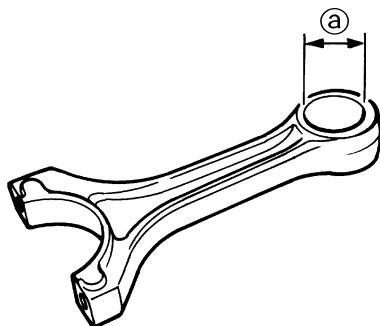
Piston pin diameter:  
21.00 mm (0.827 in)



S69J5C50

### Checking the connecting rod small end inside diameter

- Measure the connecting rod small end inside diameter ①. Replace the connecting rod if out of specification.



S69J5C40



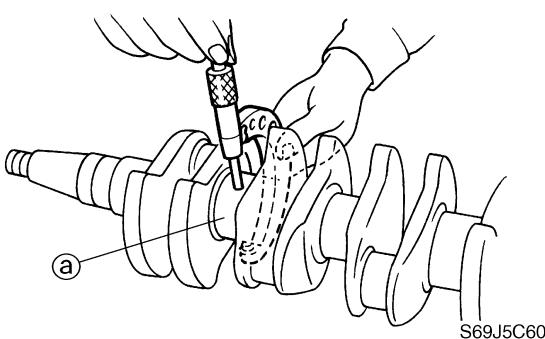
Connecting rod small end inside diameter ①:  
21.00 mm (0.827 in)

### Checking the connecting rod big end side clearance

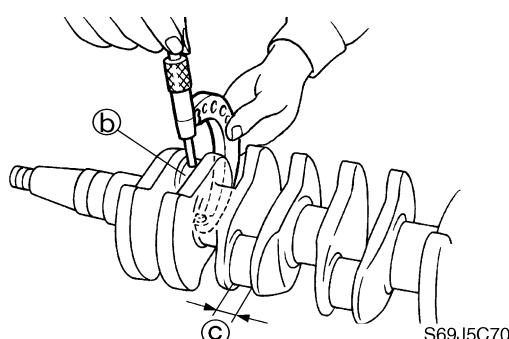
- Measure the connecting rod big end side clearance ②. Replace the connecting rod or crankshaft, or both if out of specification.

### Checking the crankshaft

- Measure the crankshaft journal diameter ③, crankpin diameter ④, and crankpin width ⑤. Replace the crankshaft if out of specification.



S69J5C60



S69J5C70



Crankshaft journal diameter ④:

62.968–62.992 mm

(2.4791–2.4800 in)

Crankpin diameter ⑤:

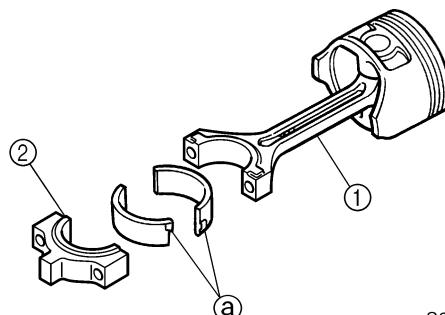
49.976–50.000 mm

(1.9676–1.9685 in)

Crankpin width ⑥:

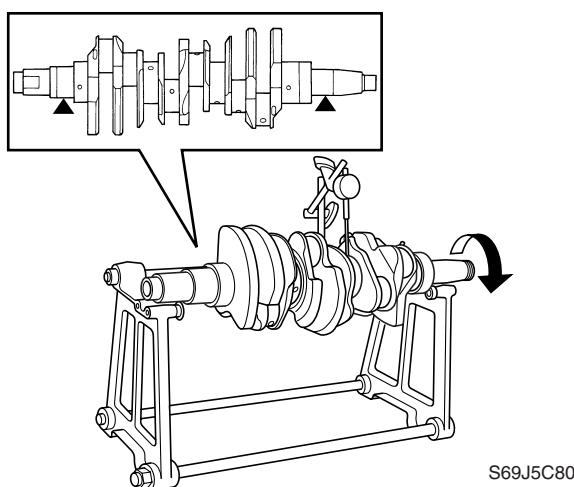
21.50–21.55 mm

(0.8465–0.8484 in)



S69J5C90

- Measure the crankshaft runout. Replace the crankshaft if out of specification.



S69J5C80



Crankshaft runout limit:

0.03 mm (0.0012 in)

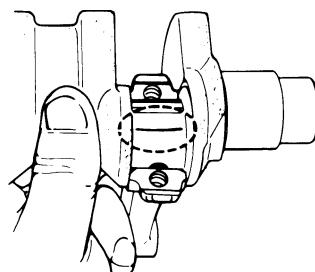
### Checking the crankpin oil clearance

- Clean the bearings and the connecting rod.
- Install the upper half of the bearing into the connecting rod ① and the lower half into the connecting rod cap ②.
- Insert the projection ④ of the bearing into the slot on the cap and connecting rod.

#### NOTE:

Install the connecting rod bearings in their original positions.

- Put a piece of Plastigauge® (PG-1) onto the crankpin, parallel to the crankshaft.

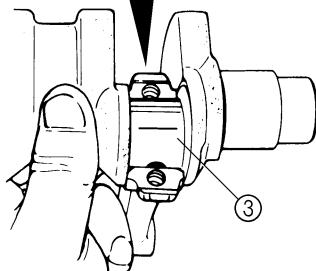
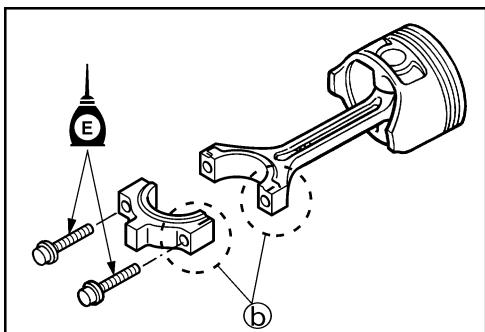


S69J5D00

#### NOTE:

Be sure not to put the Plastigauge (PG-1) over the oil hole in the crankpin of the crankshaft.

- Install the connecting rod to the crankpin ③.

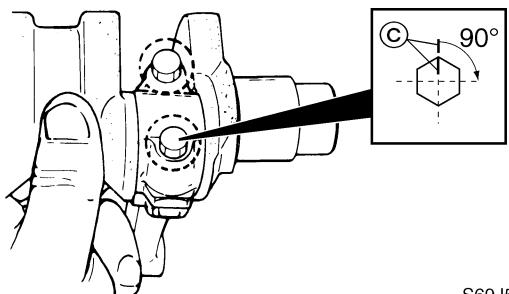


S69J5D10

**NOTE:**

Align the marks **b** on the connecting rod cap and connecting rod, which you made during disassembly.

6. Tighten the connecting rod bolts to the specified torques in three stages.



S69J5D20

**NOTE:**

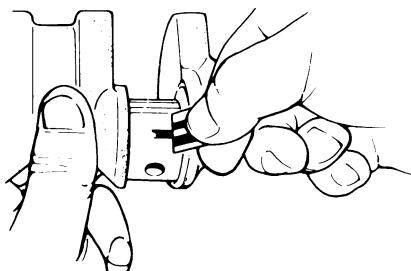
- Reuse the removed connecting rod bolts when checking the oil clearance.
- Do not turn the connecting rod until the crankpin oil clearance measurement has been completed.
- Make a mark **C** on the connecting rod bolts, connecting rod caps, and then tighten the bolts 90° from the mark.



**Connecting rod bolt:**

- 1st: 23 N·m (2.3 kgf·m, 17 ft·lb)
- 2nd: 48 N·m (4.8 kgf·m, 35 ft·lb)
- 3rd: 90°

7. Remove the connecting rod cap and measure the width of the compressed Plastigauge (PG-1) on each crankpin. Replace the connecting rod bearing if out of specification.



S69J5D30



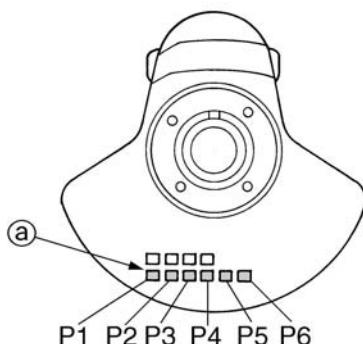
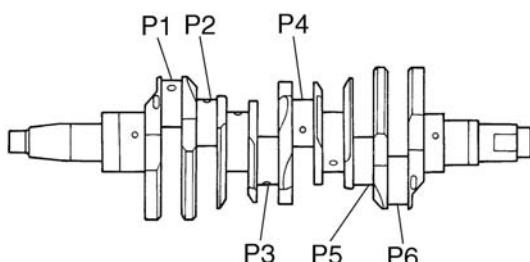
**Crankpin oil clearance:**

0.035–0.071 mm  
(0.0014–0.0028 in)

5

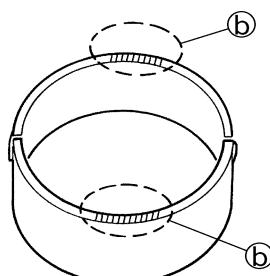
### Selecting the connecting rod bearing

1. When replacing the connecting rod bearing, select the suitable bearing as follows.
2. Check the crankpin mark **a** on the crankshaft.

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S69J5D40

3. Select the suitable color ⑤ for the connecting rod bearing from the table.



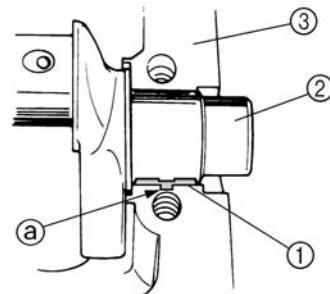
S69J5D50

Crankpin mark ④	Bearing color ⑤
92-00	Yellow
84-91	Green
76-83	Blue

### Checking the crankshaft main journal oil clearance

1. Clean the bearings, main journals, and bearing portions of the crankcase and cylinder block.
2. Place the cylinder block upside down on a bench.
3. Install half of the bearings ① and the crankshaft ② into the cylinder block ③.

4. Insert the projection ④ of the bearing into the notch in the cylinder block.

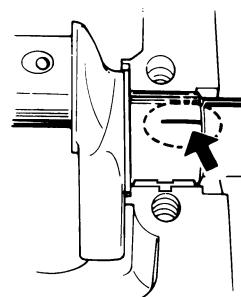


S69J5D60

**NOTE:**

Install the main bearings in their original positions.

5. Put a piece of Plastigauge (PG-1) on each main journal parallel to the crankshaft.



S69J5D70

**NOTE:**

Do not put the Plastigauge (PG-1) over the oil hole in the main journals of the crankshaft.

6. Install the remaining half of the bearings into the crankcase.

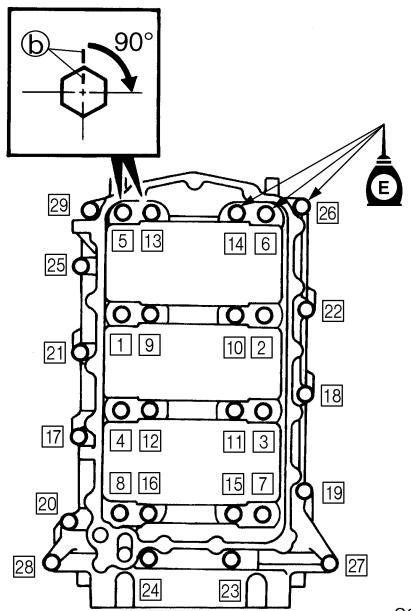
**NOTE:**

Install the main bearings in their original positions.

7. Insert the projection of the bearing into the notch in the crankcase.
8. Install the crankcase onto the cylinder block and apply engine oil to the threads of the crankcase bolts.

## Cylinder block

9. Tighten the crankcase bolts to the specified torques in two stages and in the sequence shown.



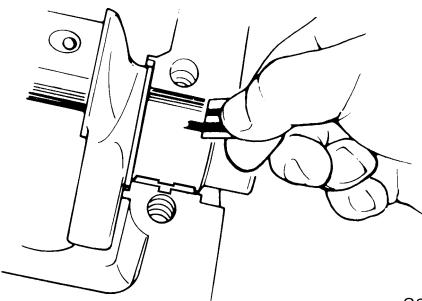
S69J5D80

**NOTE:**

- Crankcase bolts ①–⑯ can be reused five times.
- Do not move the crankshaft until the main journal oil clearance measurement has been completed.
- Tighten crankcase bolts ①–⑯ to the specified torques in two stages first, and then tighten crankcase bolts ⑰–㉙ to the specified torques in two stages.
- Make a mark ⑭ on the crankcase and crankcase bolts, and then tighten crankcase bolts ①–⑯ 90° from the mark.

	<b>①–⑧ Crankcase bolt (M8):</b> 1st: 25 N·m (2.5 kgf·m, 18 ft·lb) 2nd: 90°
	<b>⑨–⑯ Crankcase bolt (M10):</b> 1st: 40 N·m (4.0 kgf·m, 29 ft·lb) 2nd: 90°
	<b>Crankcase bolt (M8):</b> 1st: 14 N·m (1.4 kgf·m, 10 ft·lb) 2nd: 28 N·m (2.8 kgf·m, 20 ft·lb)

10. Remove the crankcase and measure the width of the compressed Plastigauge (PG-1) on each main journal. Replace the main bearing if out of specification.



S69J5D90



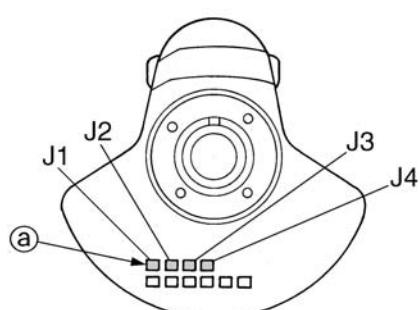
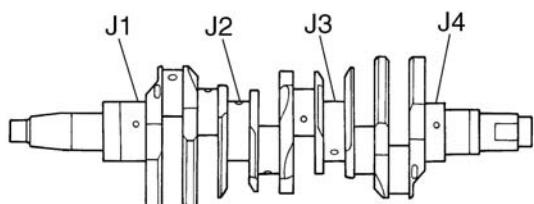
Crankshaft main journal oil clearance:

0.025–0.050 mm  
(0.0010–0.0020 in)

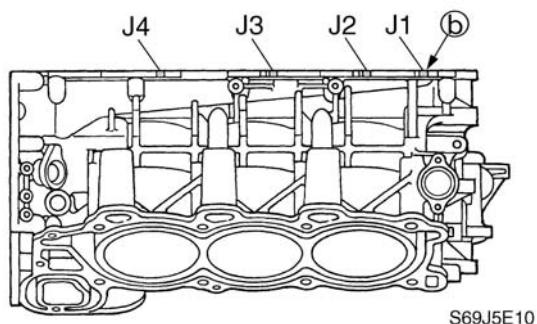
### Selecting the crankshaft main bearing

- When replacing the main bearing, select the suitable bearing as follows.
- Check the crankshaft journal mark ④ on the crankshaft and the cylinder block mark ⑤ on the cylinder block.

5

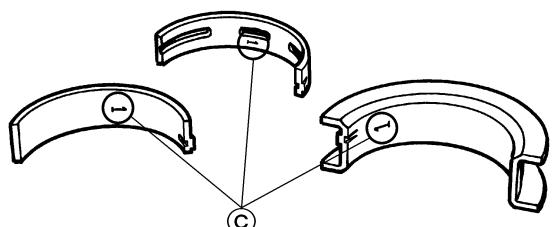


S69J5E00

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S69J5E10

3. Select the suitable main bearing number **©** from the table.



S69J5E20

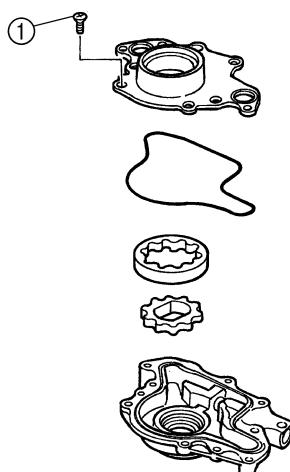
		Cylinder block mark <b>(b)</b>																								
		98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22
Crankshaft journal mark <b>(a)</b>		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	©	92	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	
91	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	
90	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	
89	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	
88	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	
87	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	
86	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	
85	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	3	
84	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	3	
83	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	
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80	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	
79	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	
78	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	
77	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	
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73	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	
72	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	
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69	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
68	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	

**NOTE:**

- Example: If the crankshaft journal mark **(a)** is "81" and the cylinder block mark **(b)** is "04," then the main bearing number **©** is "1."
- Main bearing #3 is a thrust bearing.

**Disassembling the oil pump**

1. Remove the screws **①** and disassemble the oil pump.



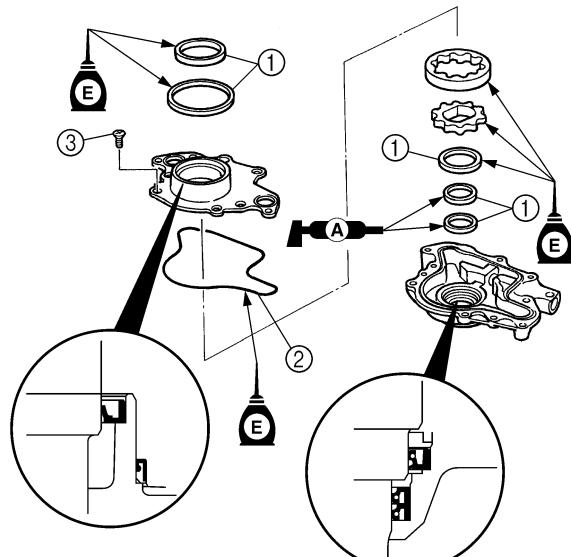
S69J5E60

**Checking the oil pump**

1. Check the oil seals and gasket for tears. Replace if necessary.
2. Check the teeth of the gears for cracks or wear and the oil pump case for scratches. Replace if necessary.

**Assembling the oil pump**

1. Replace the new oil seal **①** and gasket **②** if necessary, and then tighten the screws **③** to the specified torque.



S69J5E70

**NOTE:**

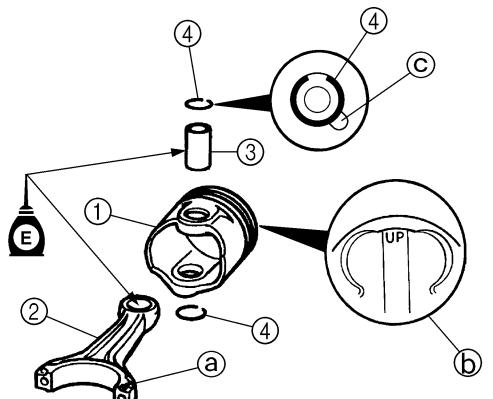
Install the oil seals using a general pipe of the proper size.



Screw ③:  
4 N·m (0.4 kgf·m, 2.9 ft·lb)

## Assembling the piston and cylinder block

1. Assemble the piston ①, connecting rod ②, piston pin ③, and new piston pin clips ④.

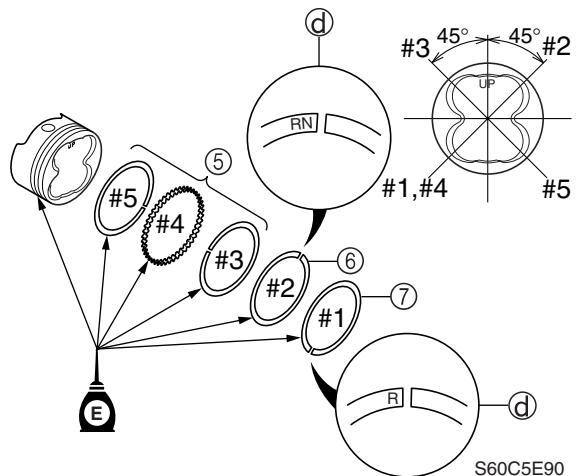


S69J5E80

**NOTE:**

- Face the mark ⑨ on the connecting rod in the same direction as the “UP” mark ⑩ on the piston, which you made during disassembly.
- Always use new piston pin clips, and do not allow the piston pin clip end to align with the piston pin slot ⑪.

2. Install the oil ring ⑫, second ring ⑬, and top ring ⑭ to the piston with the “R” mark ⑮ of the second ring and the “RN” mark ⑯ of the top ring facing upward.
3. Offset the piston ring end gaps as shown.



S60C5E90

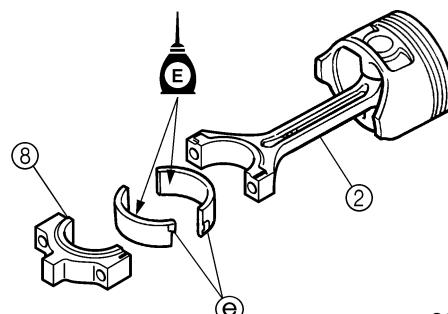
**CAUTION:**

Do not scratch the piston or break the piston rings.

**NOTE:**

After installing the piston rings, check that they move smoothly.

4. Install the upper half of the bearing into the connecting rod ⑰ and the lower half into the connecting rod cap ⑱.
5. Insert the projection ⑲ of the bearing into the slot on the cap and connecting rod.



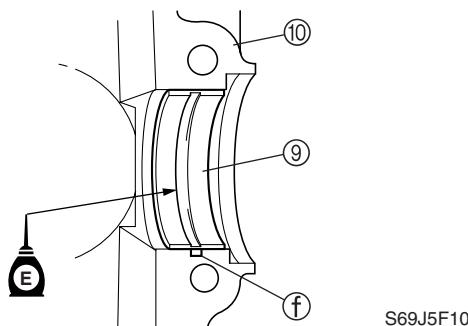
S69J5F00

**NOTE:**

Install the connecting rod bearings in their original positions.

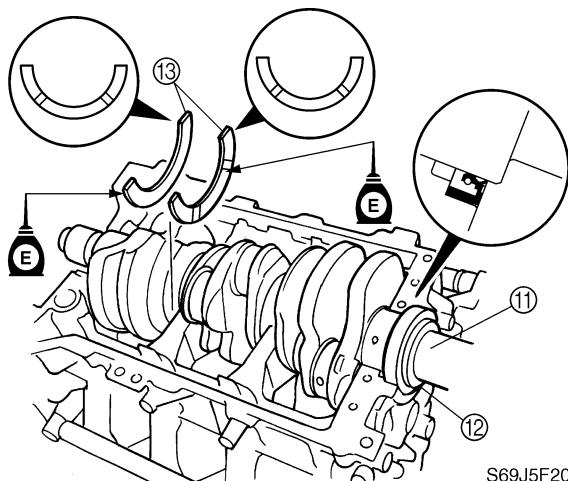
**POWR****Power unit**

6. Install half of the bearings ⑨ into the cylinder block ⑩.
7. Insert the projection ⑫ of the bearing into the notch in the cylinder block.

**NOTE:**

Install the main bearings in their original positions.

8. Set the crankshaft ⑪, and oil seal ⑫, and thrust bearings ⑬ into the cylinder block as shown.

**NOTE:**

Apply engine oil to the inner oil seal and the thrust bearings before installation.

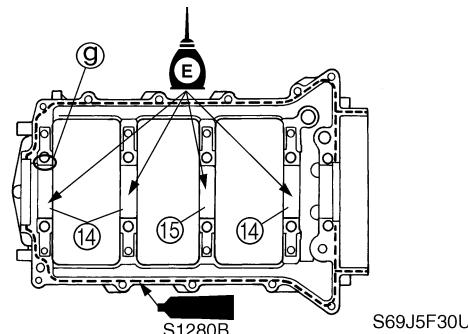
9. Install half of the bearings ⑭ and the thrust bearing ⑮ into the crankcase.

**NOTE:**

Install the main bearings in their original positions.

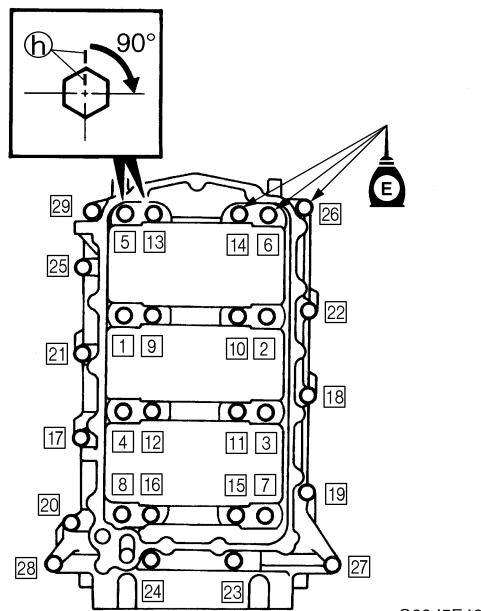
10. Apply sealant to the mating surface of the crankcase.

11. Insert the projection ⑯ of the bearing into the notch in the crankcase.

**NOTE:**

Do not get any sealant on the journal bearings.

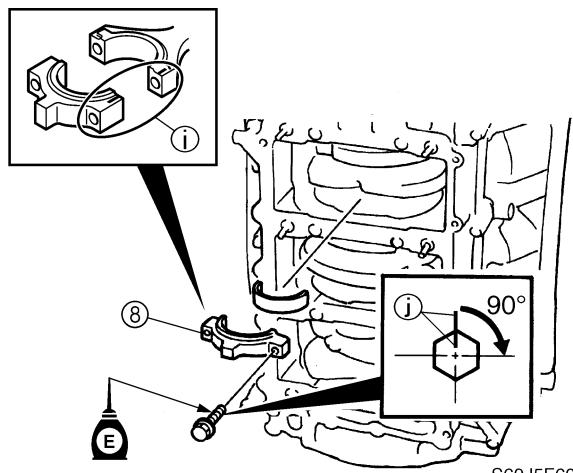
12. Install the crankcase onto the cylinder block, and then tighten the crankcase bolts to the specified torques in two stages and in the sequence shown.

**CAUTION:**

Crankcase bolts ①–⑯ can be reused five times.

**NOTE:**

- The oil seals must be installed before tightening the crankcase bolts.
- Apply engine oil to the crankcase bolts before installation.
- Tighten crankcase bolts ①–⑯ to the specified torques in two stages first, and then tighten crankcase bolts ⑰–㉙ to the specified torques in two stages.
- Make a mark ⑩ on the crankcase and crankcase bolts, and then tighten crankcase bolts ①–⑯ 90° from the mark.

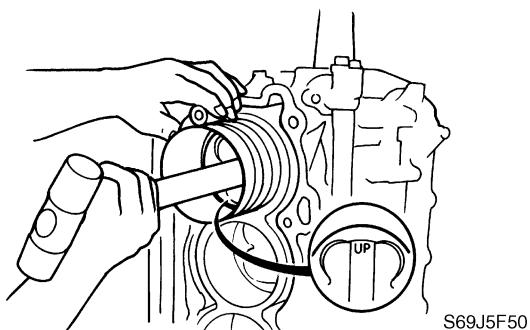


S69J5F60



①–⑧ Crankcase bolt (M8):
1st: 25 N·m (2.5 kgf·m, 18 ft·lb)
2nd: 90°
⑨–⑯ Crankcase bolt (M10):
1st: 40 N·m (4.0 kgf·m, 29 ft·lb)
2nd: 90°
Crankcase bolt (M8):
1st: 14 N·m (1.4 kgf·m, 10 ft·lb)
2nd: 28 N·m (2.8 kgf·m, 20 ft·lb)

13. Install the piston with the “UP” mark on the piston crown facing towards the flywheel magnet.



S69J5F50

**NOTE:**

Apply engine oil to the side of the piston and piston rings before installation.



Piston ring compressor: YM-08037

14. Install the connecting rod cap ⑧ to the connecting rod, and then tighten the connecting rod bolts to the specified torques in three stages.

**CAUTION:**

**Do not reuse the connecting rod bolts, always replace them with new ones.**

**NOTE:**

- Align the marks ⑩ on the connecting rod cap and connecting rod, which you made during disassembly.
- Apply engine oil to the connecting rod cap and connecting rod bolt before installation.
- Make a mark ⑪ on the connecting rod bolts and connecting rod caps, and then tighten the bolts 90° from the mark.

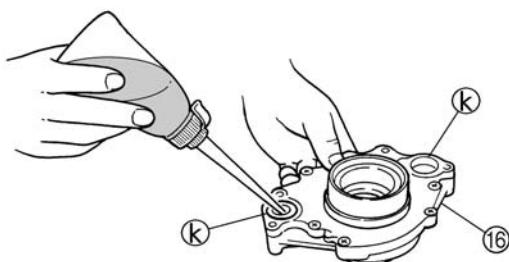
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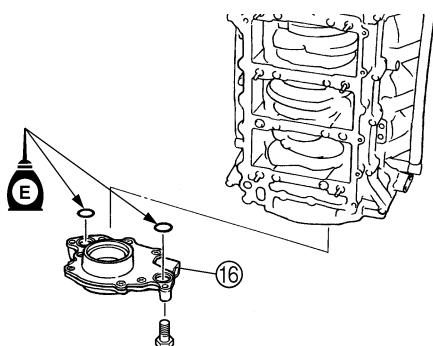
Connecting rod bolt:

1st: 23 N·m (2.3 kgf·m, 17 ft·lb)
2nd: 48 N·m (4.8 kgf·m, 35 ft·lb)
3rd: 90°

15. Install the oil pump ⑯ by aligning the oil pump gear with the crankshaft.



S69J5F70

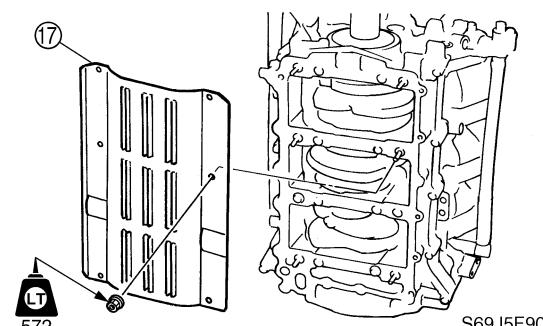
**POWR****Power unit**

S69J5F80

**CAUTION:**

**Before installing the oil pump, be sure to fill it with engine oil through the oil passage ⑯.**

16. Install the baffle plate ⑯ to the specified torque.

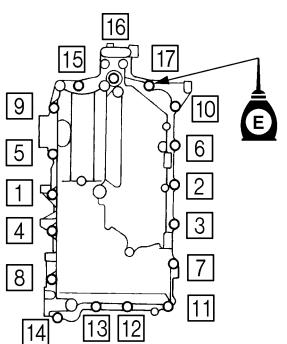


S69J5F90

**Baffle plate nut:**

12 N·m (1.2 kgf·m, 8.7 ft·lb)

17. Install the new gasket and crankcase cover, and then tighten the bolts to the specified torque in two stages and in the sequence shown.



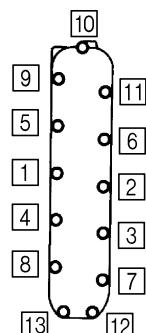
S69J5G00

**Crankcase cover bolt:**

1st: 14 N·m (1.4 kgf·m, 10 ft·lb)

2nd: 28 N·m (2.8 kgf·m, 20 ft·lb)

18. Install the new gasket and cooling water passage cover, and then tighten the bolts to the specified torque in the sequence shown.

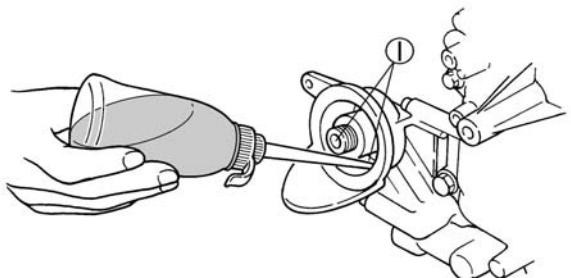


S69J5G10

**Cooling water passage cover bolt:**

12 N·m (1.2 kgf·m, 8.7 ft·lb)

19. Before installing the power unit, be sure to fill it with engine oil through the oil passage ① of the oil filter bracket.



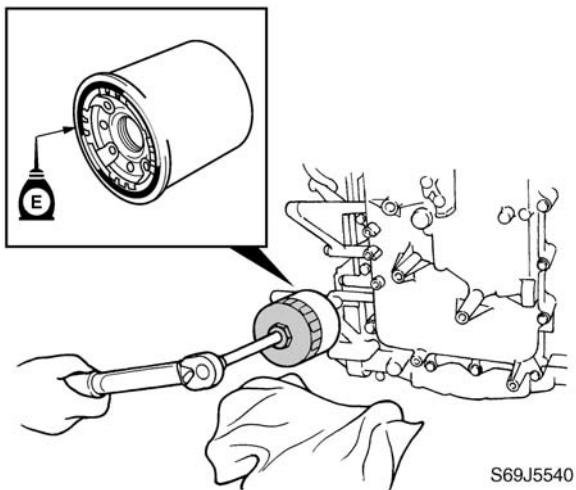
S69J5G20

**NOTE:**

Apply a thin coat of engine oil to the O-ring of the new oil filter before installation.

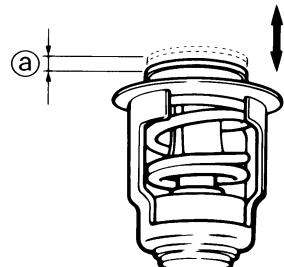
## Cylinder block

20. Install the oil filter, and then tighten it to the specified torque using a 72.5 mm (2.9 in) oil filter wrench.



Oil filter: 18 N·m (1.8 kgf·m, 13 ft·lb)

4. Check the thermostat valve opening at the specified water temperatures. Replace if out of specification.

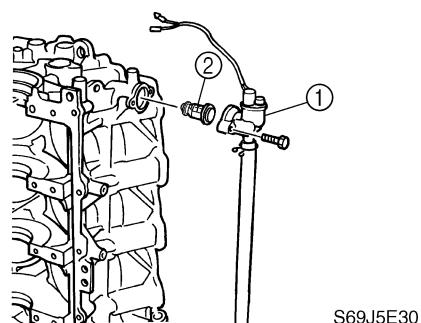


S69J5E50

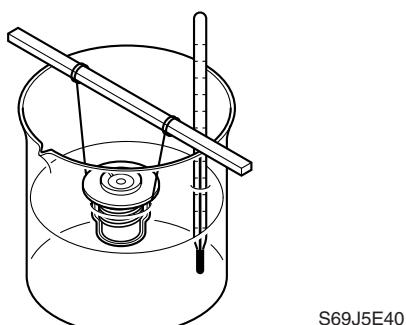
Water temperature	Valve lift $\textcircled{a}$
58–62 °C (136–144 °F)	0 mm (0 in) (valve begins to lift)
above 70 °C (158 °F)	more than 4.3 mm (0.17 in)

### Checking the thermostat

1. Remove the cover  $\textcircled{1}$  and thermostat  $\textcircled{2}$ .



2. Suspend the thermostat in a container of water.  
3. Place a thermometer in the water and slowly heat the water.

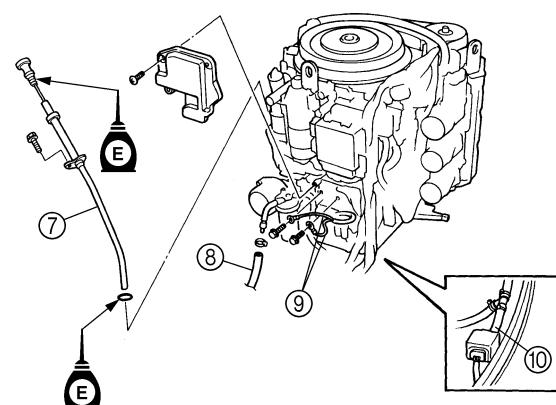
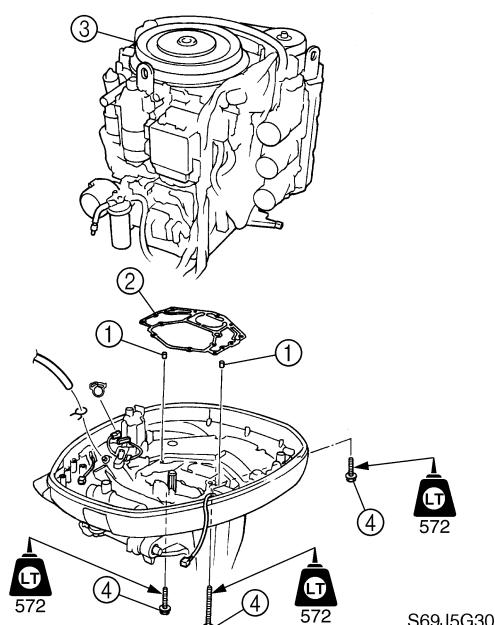


5. Install the thermostat and cover.

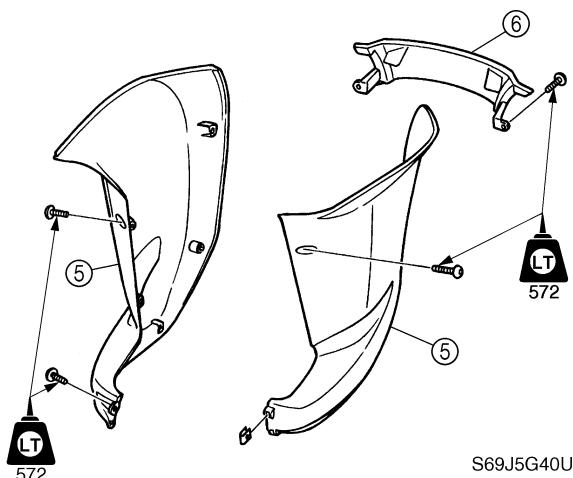
### Installing the power unit

1. Clean the power unit matching surface, and install the dowel pins  $\textcircled{1}$  and the new gasket  $\textcircled{2}$ .  
2. Install the power unit  $\textcircled{3}$  by installing the bolts  $\textcircled{4}$ , then tightening them to the specified torque.  
3. Install the aprons  $\textcircled{5}$  and upper case cover  $\textcircled{6}$ , then tighten them to the specified torque.  
4. Connect the fuel pump driver and isolator couplers, PTT switch coupler, shift cut switch coupler, neutral switch coupler, trim sensor coupler, and cooling water pilot hose.

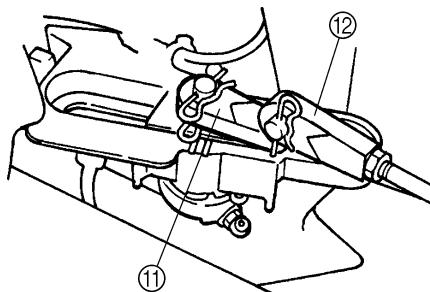
5

**POWR****Power unit**

**PTT motor lead bolt:**  
4 N·m (0.4 kgf·m, 2.9 ft·lb)



6. Connect the shift cable ⑪ and throttle cable ⑫, and then adjust their lengths. For adjustment procedures, see Chapter 3, "Checking the throttle link and throttle cable operation," and "Checking the gearshift operation."

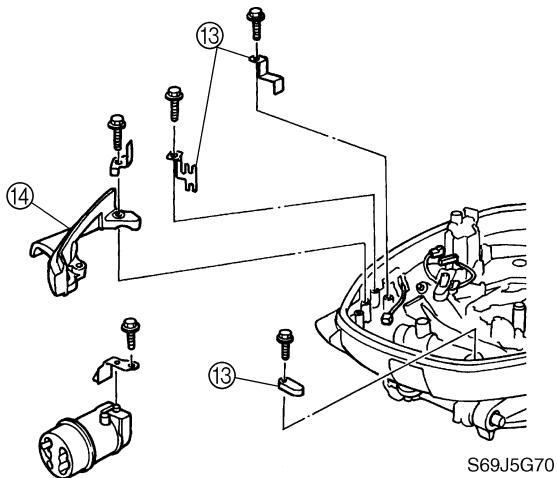


**Mounting bolt ④:**  
42 N·m (4.2 kgf·m, 30 ft·lb)  
**Apron and upper case cover bolt:**  
8 N·m (0.8 kgf·m, 5.8 ft·lb)

5. Install the dipstick guide ⑦, and connect the fuel hose ⑧, PTT motor leads ⑨, and flushing device hose (flushing device model) ⑩.

## Cylinder block

7. Install the holders ⑬ and retaining plate ⑭.



**NOTE:**

Apply engine oil to the flywheel magnet nut before installation.



Flywheel magnet holder: YB-06139

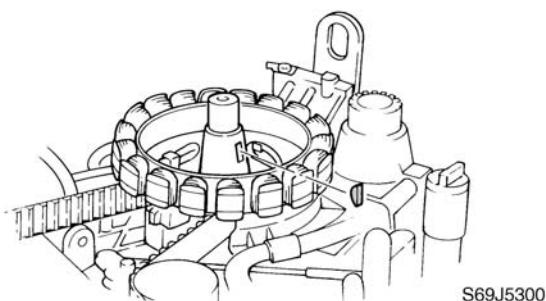


Flywheel magnet nut:  
240 N·m (24 kgf·m, 174 ft·lb)

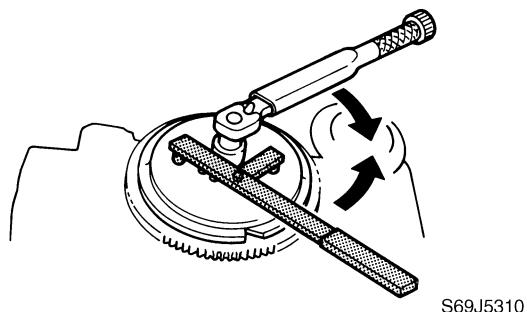
11. Reinstall the all removed parts.

8. Install the stator coil bracket and stator coil.

9. Install the Woodruff key.



10. Install the flywheel magnet.



**CAUTION:**

Apply force in the direction of the arrows shown, to prevent the flywheel holder from slipping off easily.



## Lower unit

<b>Special service tools .....</b>	<b>6-1</b>
<b>Lower unit (regular rotation model) .....</b>	<b>6-4</b>
Removing the lower unit.....	6-7
Removing the water pump and shift rod.....	6-7
Checking the water pump and shift rod .....	6-8
<b>Propeller shaft housing (regular rotation model) .....</b>	<b>6-9</b>
Removing the propeller shaft housing assembly .....	6-11
Disassembling the propeller shaft assembly .....	6-11
Disassembling the propeller shaft housing.....	6-11
Checking the propeller shaft housing .....	6-12
Checking the propeller shaft.....	6-12
Assembling the propeller shaft assembly .....	6-13
Assembling the propeller shaft housing.....	6-13
<b>Drive shaft and lower case (regular rotation model) .....</b>	<b>6-15</b>
Removing the drive shaft.....	6-17
Disassembling the drive shaft housing .....	6-17
Disassembling the forward gear .....	6-17
Disassembling the lower case .....	6-17
Checking the pinion and forward gear.....	6-18
Checking the bearings.....	6-18
Checking the drive shaft.....	6-18
Checking the lower case .....	6-18
Assembling the lower case.....	6-18
Assembling the forward gear .....	6-19
Assembling the drive shaft housing.....	6-19
Installing the drive shaft.....	6-19
Installing the propeller shaft housing .....	6-20
Installing the water pump and shift rod.....	6-20
Installing the lower unit .....	6-22
<b>Shimming (regular rotation model) .....</b>	<b>6-24</b>
Shimming.....	6-25
Selecting the pinion shims.....	6-25
Selecting the forward gear shims .....	6-26
Selecting the reverse gear shims .....	6-27
<b>Backlash (regular rotation model).....</b>	<b>6-28</b>
Measuring the forward and reverse gear backlash .....	6-28
<b>Lower unit (counter rotation model) .....</b>	<b>6-30</b>
Removing the lower unit.....	6-33
Removing the water pump and shift rod.....	6-33
Checking the water pump and shift rod .....	6-34

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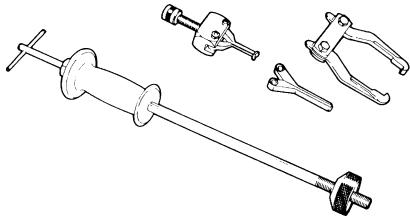
<b>Propeller shaft housing (counter rotation model) .....</b>	<b>6-35</b>
Removing the propeller shaft housing assembly .....	6-37
Disassembling the propeller shaft housing .....	6-37
Checking the propeller shaft housing .....	6-38
Checking the propeller shaft .....	6-38
Assembling the propeller shaft housing.....	6-39
<b>Drive shaft and lower case (counter rotation model) .....</b>	<b>6-41</b>
Removing the drive shaft.....	6-43
Disassembling the drive shaft housing .....	6-43
Disassembling the reverse gear .....	6-43
Disassembling the lower case .....	6-43
Checking the pinion and reverse gear .....	6-44
Checking the bearings.....	6-44
Checking the drive shaft .....	6-44
Checking the lower case .....	6-44
Assembling the lower case .....	6-44
Assembling the drive shaft housing .....	6-45
Installing the drive shaft.....	6-46
Installing the propeller shaft housing .....	6-46
Installing the water pump and shift rod.....	6-47
Installing the lower unit .....	6-48
<b>Shimming (counter rotation model) .....</b>	<b>6-50</b>
Shimming.....	6-51
Selecting the pinion shims.....	6-51
Selecting the reverse gear shims .....	6-52
Selecting the forward gear shims .....	6-52
Selecting the propeller shaft shims.....	6-54
<b>Backlash (counter rotation model).....</b>	<b>6-54</b>
Measuring the forward and reverse gear backlash .....	6-54

**LOWR**

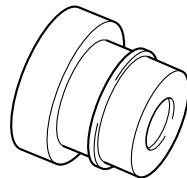


**Lower unit**

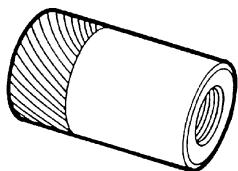
## Special service tools



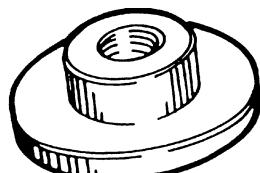
**Slide hammer and adapters**  
YB-06096



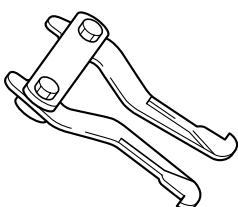
**Drive shaft needle bearing remover and installer**  
YB-06196  
**Needle bearing installer and remover**  
YB-06194



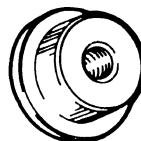
**Propeller shaft and bearing housing remover**  
YB-06335



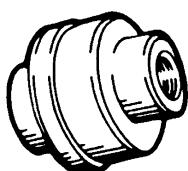
**Forward bearing installer**  
YB-06430



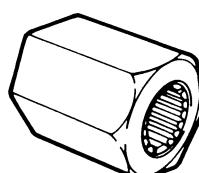
**Puller claw**  
YB-06523



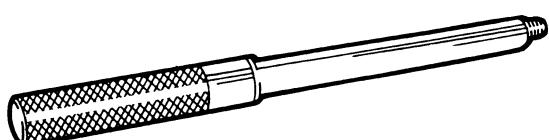
**Bearing outer race attachment**  
YB-06109



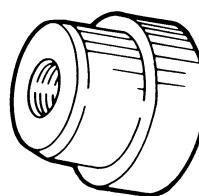
**Oil seal installer**  
YB-06168, YB-06195



**Drive shaft holder**  
YB-06201

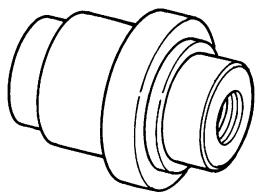


**Driver handle**  
YB-06071

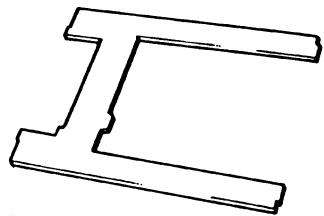


**Roller bearing installer/remover**  
YB-06432

## Special service tools



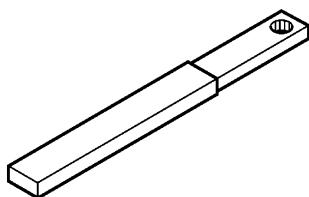
Needle bearing installer  
YB-06434, YB-06435



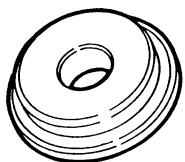
Shimming gauge I  
YB-06439



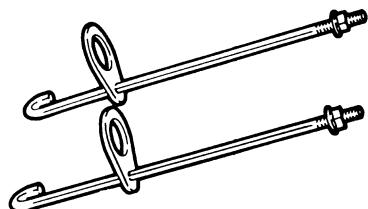
Pinion gear bushing installer  
YB-06029-4



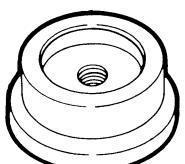
Shift rod push arm  
YB-06052



Needle bearing remover and installer  
YB-06213

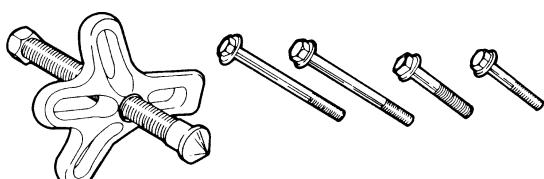


Bearing housing puller  
YB-06207

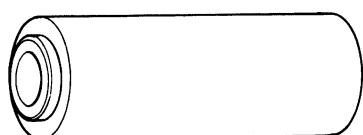


Taper roller bearing installer  
YB-06431

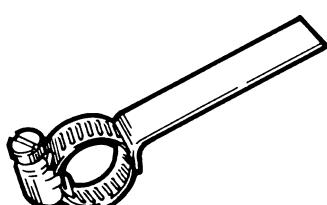
Forward gear bearing cup installer  
YB-06276-B



Universal puller  
YB-06117



Pinion shimming gauge III  
YB-06441



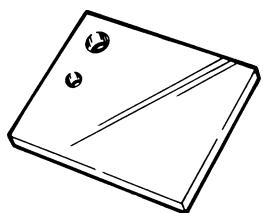
Backlash indicator gauge  
YB-06265

**LOWR**

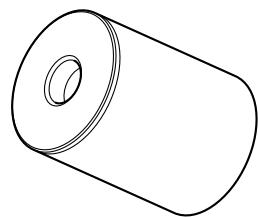


**Lower unit**

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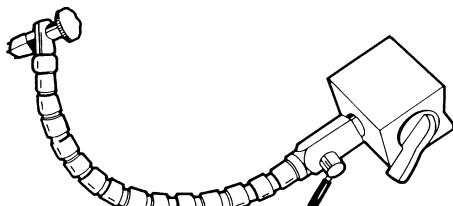
**Magnetic plate**  
YB-07003



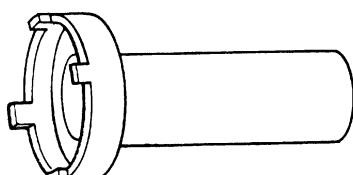
**Shimming gauge**  
YB-06440-A



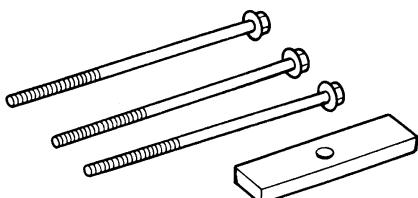
**Dial gauge**  
YU-03097



**Magnetic flexible stand**  
YU-34481



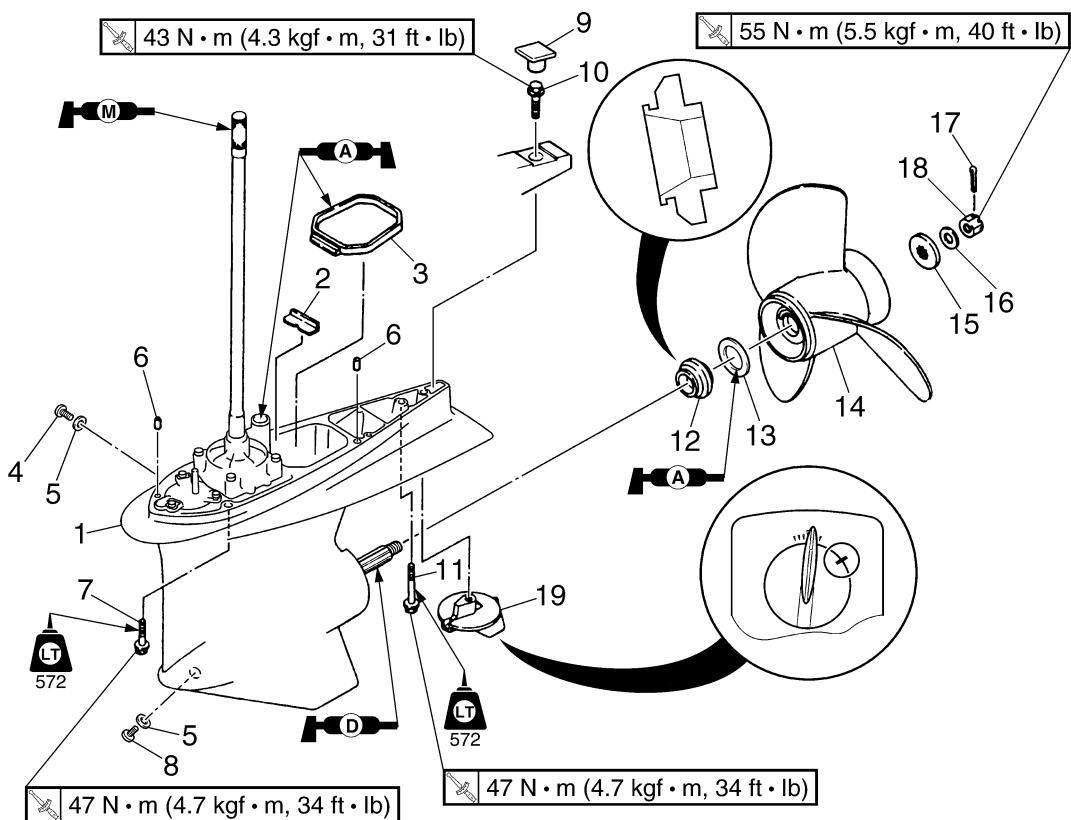
**Ring nut wrench**  
YB-06578



**Puller bolt**  
YB-41707

## Special service tools / Lower unit (regular rotation model)

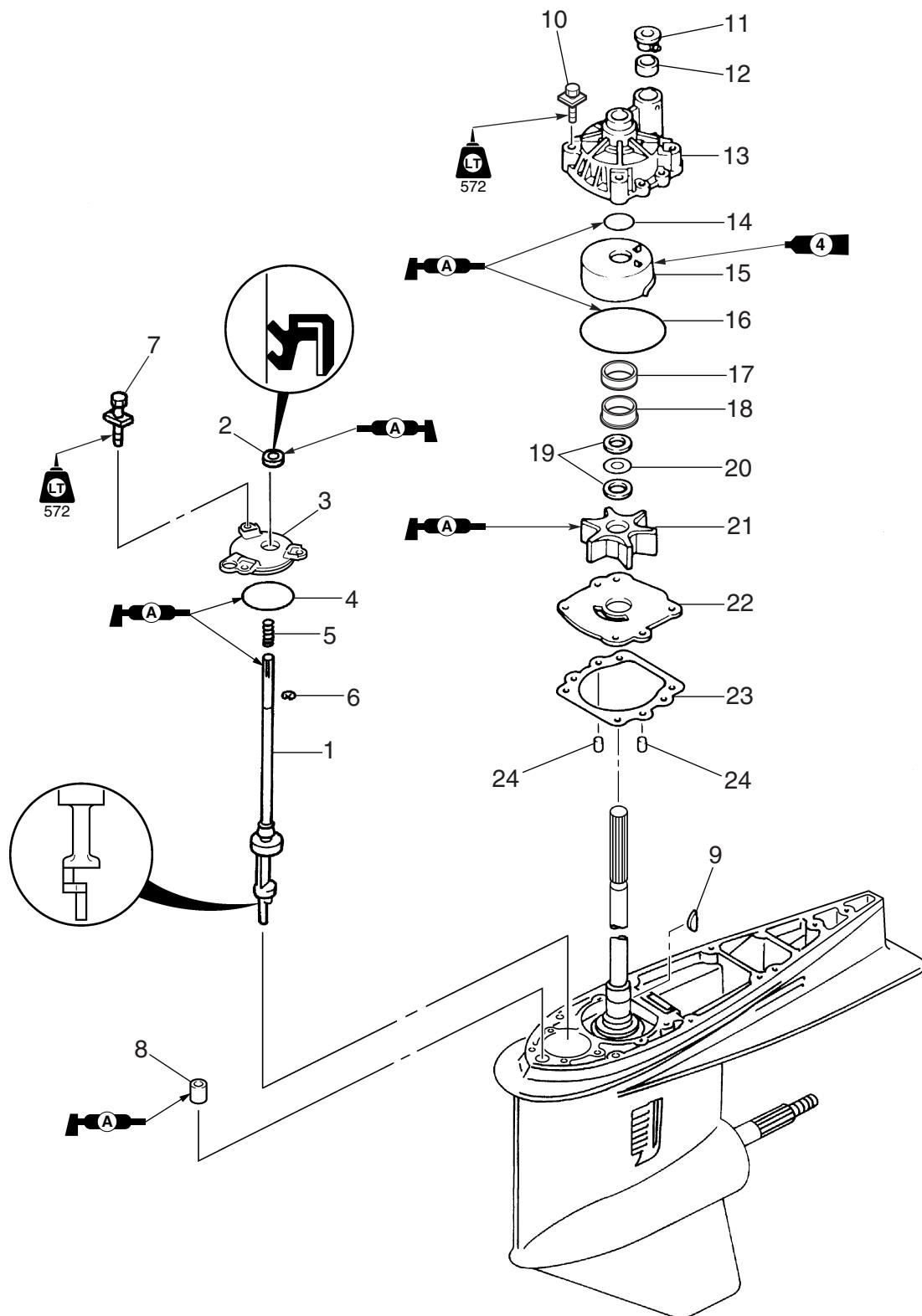
### Lower unit (regular rotation model)



S69J6005U

6

No.	Part name	Q'ty	Remarks
1	Lower unit	1	
2	Plate	1	
3	Rubber seal	1	
4	Check screw	1	
5	Gasket	2	<b>Not reusable</b>
6	Dowel pin	2	
7	Bolt	7	M10 × 45 mm
8	Drain screw	1	
9	Grommet	1	
10	Bolt	1	M10 × 44 mm
11	Bolt	1	M10 × 70 mm
12	Spacer	1	
13	Washer	1	
14	Propeller	1	
15	Washer	1	
16	Washer	1	
17	Cotter pin	1	<b>Not reusable</b>
18	Propeller nut	1	
19	Trim tab	1	

**LOWR****Lower unit**

S69J6010U

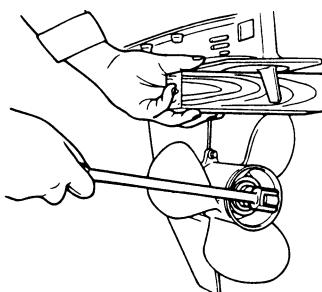
## Lower unit (regular rotation model)

No.	Part name	Q'ty	Remarks
1	Shift rod	1	
2	Oil seal	1	<b>Not reusable</b>
3	Oil seal housing	1	
4	O-ring	1	<b>Not reusable</b> 3.1 × 70.6 mm
5	Spring	1	
6	Circlip	1	
7	Bolt	3	M6 × 20 mm
8	Seal	1	
9	Woodruff key	1	
10	Bolt	4	M8 × 45 mm
11	Cover	1	
12	Seal	1	
13	Water pump housing	1	
14	O-ring	1	<b>Not reusable</b> 2.5 × 42 mm
15	Insert cartridge	1	
16	O-ring	1	<b>Not reusable</b> 2.5 × 91.5 mm
17	Collar	1	
18	Spacer	1	
19	Washer	2	
20	Wave washer	1	
21	Impeller	1	
22	Outer plate cartridge	1	
23	Gasket	1	<b>Not reusable</b>
24	Dowel pin	2	

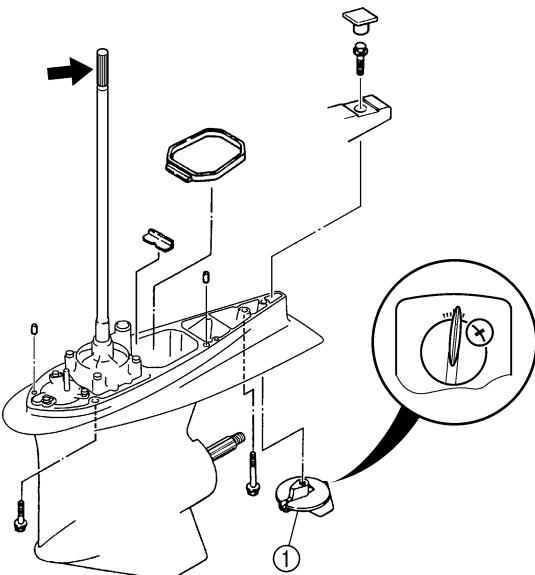
**LOWR****Lower unit**

### Removing the lower unit

1. Drain the gear oil. For draining procedures, see Chapter 3, "Changing the gear oil."
2. Set the gearshift to the neutral position, and place a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning, and then remove the propeller nut and propeller.



S69J6015



S69J6020

#### **⚠ WARNING**

**Do not hold the propeller with your hands when loosening or tightening it. Be sure to disconnect the battery cables from the batteries and the engine stop lanyard switch. Put a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning.**

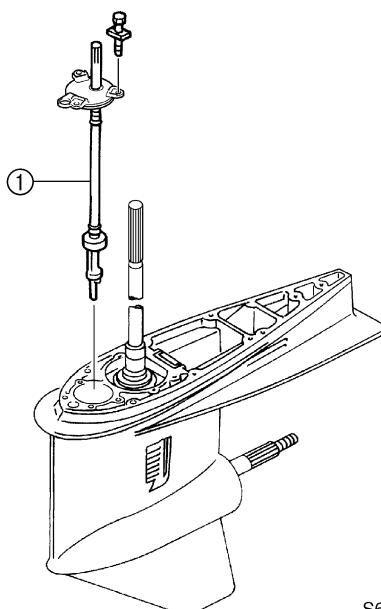
3. Mark the trim tab ① at the area shown, and then remove it.
4. Loosen the bolts, and then remove the lower unit from the upper case.

#### **NOTE:**

Check that there is no oil on the spline and check it for wear.

### Removing the water pump and shift rod

1. Remove the water pump assembly and shift rod assembly ①.

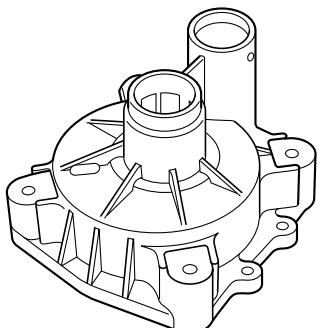


S69J6025

## Lower unit (regular rotation model)

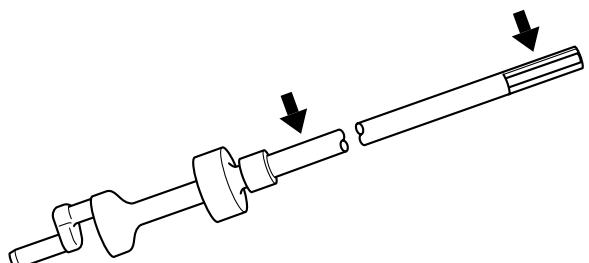
### Checking the water pump and shift rod

1. Check the water pump housing for deformation. Replace if necessary.



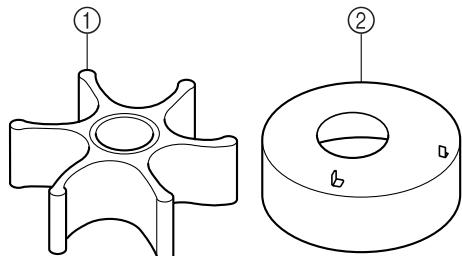
S69J6030

4. Check the shift rod for cracks or wear. Replace if necessary.



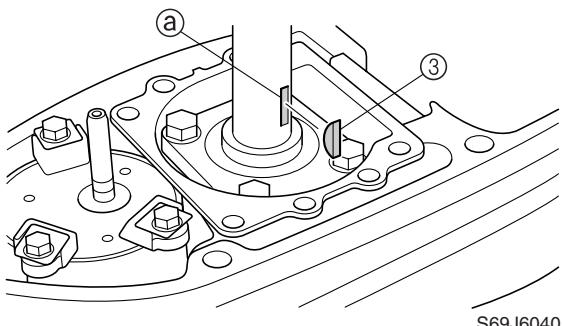
S69J6045

2. Check the impeller ① and insert cartridge ② for cracks or wear. Replace if necessary.

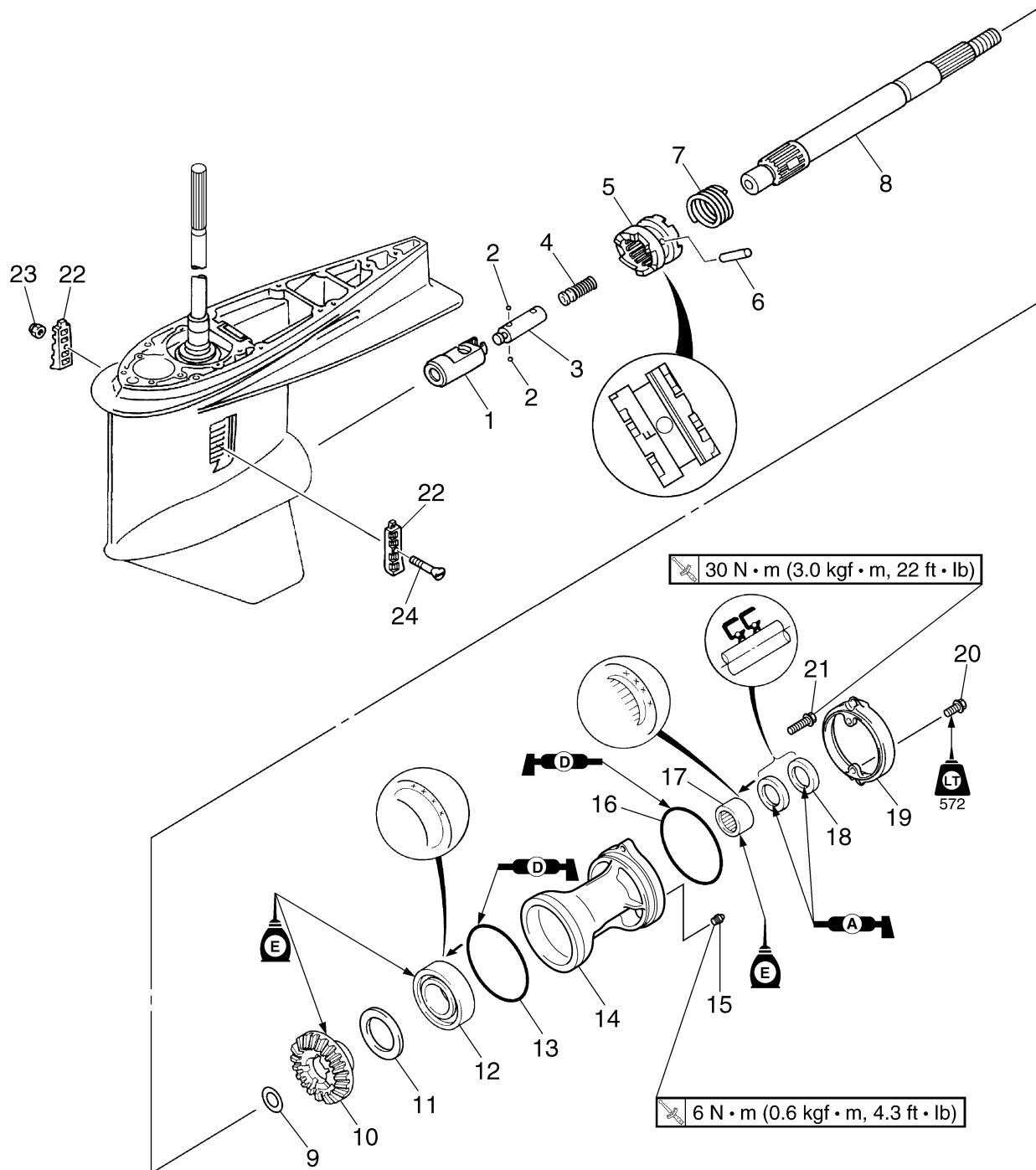


S69J6035

3. Check the Woodruff key ③ and the groove ④ on the drive shaft for wear. Replace if necessary.



S69J6040

**LOWR****Lower unit****Propeller shaft housing (regular rotation model)**

S69J6050

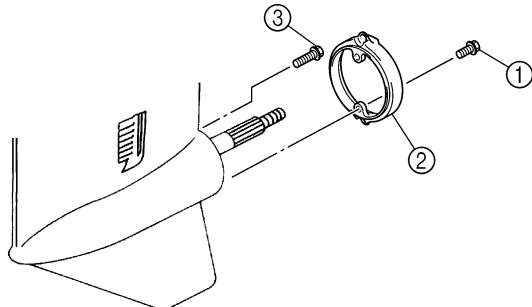
## Propeller shaft housing (regular rotation model)

No.	Part name	Q'ty	Remarks
1	Shift rod joint	1	
2	Ball	2	
3	Slider	1	
4	Shift plunger	1	
5	Dog clutch	1	
6	Cross pin	1	
7	Spring	1	
8	Propeller shaft	1	
9	Washer	1	
10	Reverse gear	1	
11	Reverse gear shim	—	As required
12	Ball bearing	1	<b>Not reusable</b>
13	O-ring	1	<b>Not reusable</b> 3.1 × 110.6 mm
14	Propeller shaft housing	1	
15	Grease nipple	1	
16	O-ring	1	<b>Not reusable</b>
17	Needle bearing	1	
18	Oil seal	2	<b>Not reusable</b> 3.1 × 110.6 mm
19	Ring	1	
20	Bolt	2	M8 × 20 mm
21	Bolt	2	M8 × 30 mm
22	Cooling water inlet cover	2	
23	Nut	1	
24	Screw	1	

**LOWR****Lower unit**

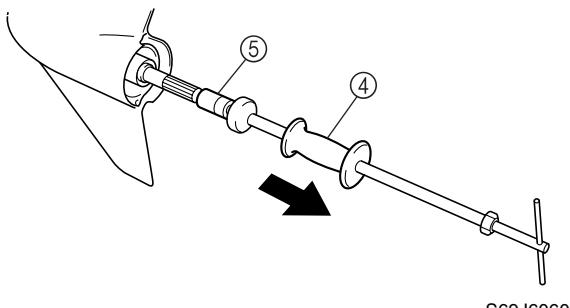
## Removing the propeller shaft housing assembly

1. Remove the bolts ①, ring ②, and bolts ③.



S69J6055

2. Pull out the propeller shaft housing assembly.

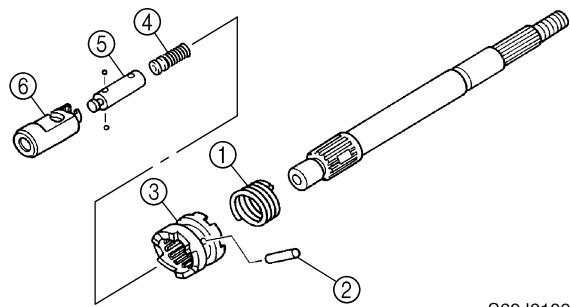


S69J6060

Slide hammer and adapters ④:  
YB-06096Propeller shaft and bearing housing remover ⑤:  
YB-06335

## Disassembling the propeller shaft assembly

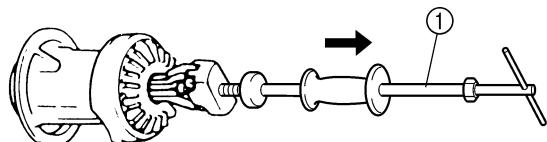
1. Remove the spring ①, and then remove the cross pin ②, dog clutch ③, slider ④, shift plunger ⑤, and shift rod joint ⑥.



S69J6100

## Disassembling the propeller shaft housing

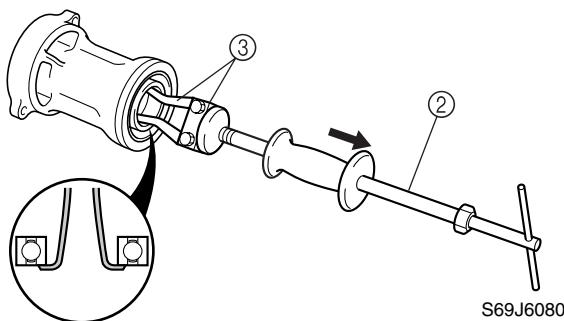
1. Remove the reverse gear and reverse gear shim(s).



S69J6070

Slide hammer and adapters ①:  
YB-06096

2. Remove the ball bearing.



S69J6080

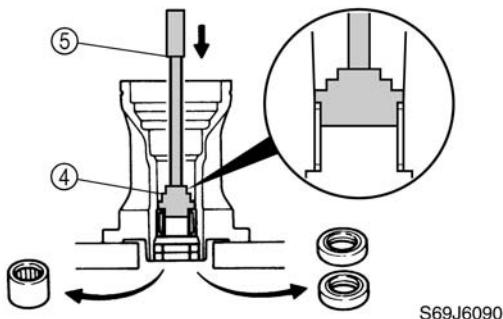
### CAUTION:

**Do not reuse the bearing, always replace it with a new one.**

Slide hammer and adapters ②:  
YB-06096  
Puller claw ③: YB-06523

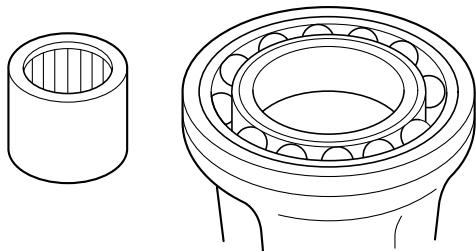
## Propeller shaft housing (regular rotation model)

3. Remove the oil seals and needle bearing.



 Oil seal installer ④: YB-06168  
Driver handle ⑤: YB-06071

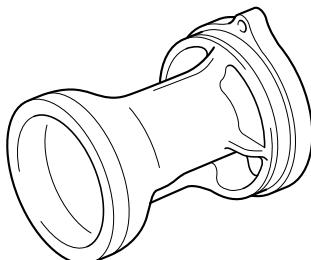
3. Check the bearings for pitting or rumbling. Replace if necessary.



S69J6115

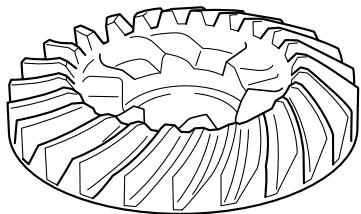
### Checking the propeller shaft housing

1. Clean the propeller shaft housing using a soft brush and cleaning solvent, and then check it for cracks or damage. Replace if necessary.



S69J6105

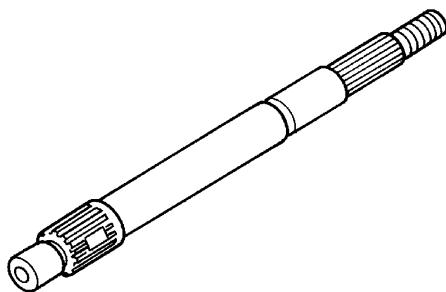
2. Check the teeth and dogs of the reverse gear for cracks or wear. Replace the gear if necessary.



S69J6110

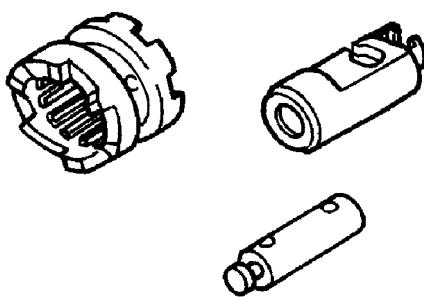
### Checking the propeller shaft

1. Check the propeller shaft for bends or wear. Replace if necessary.



S69J6120

2. Check the dog clutch, shift rod joint, and shift slider for cracks or wear. Replace if necessary.



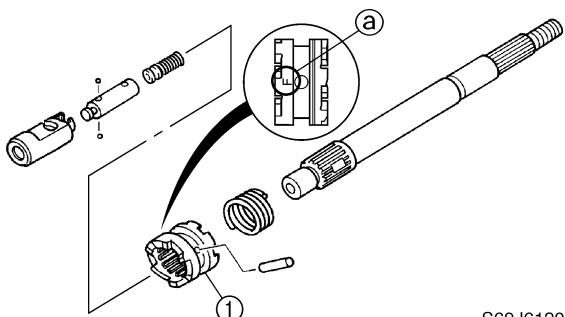
S69J6125

6

**LOWR****Lower unit**

## Assembling the propeller shaft assembly

1. Install the dog clutch ① as shown.



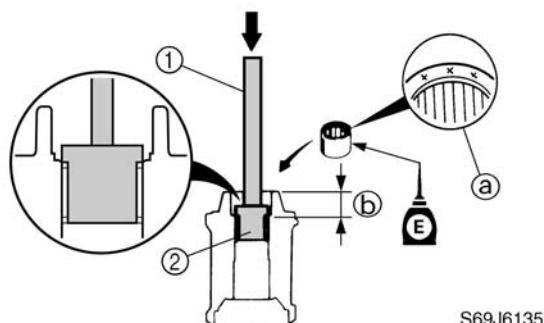
S69J6130

**NOTE:**

Install the dog clutch ① with the "F" mark ② facing toward the shift plunger.

## Assembling the propeller shaft housing

1. Install the needle bearing into the propeller shaft housing to the specified depth.



S69J6135

**NOTE:**

Install the needle bearing with the manufacture identification mark ③ facing toward the oil seal (propeller side).

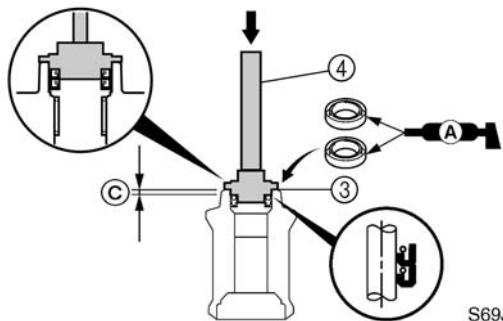


Driver handle ①: YB-06071  
Drive shaft needle bearing remover and installer ②:  
YB-06196



Depth ④:  
25.05–25.55 mm (0.986–1.006 in)

2. Apply grease to the new oil seals, and then install them into the propeller shaft housing to the specified depth.



S69J6145

**NOTE:**

Install an oil seal halfway into the propeller shaft housing, then the other oil seal.

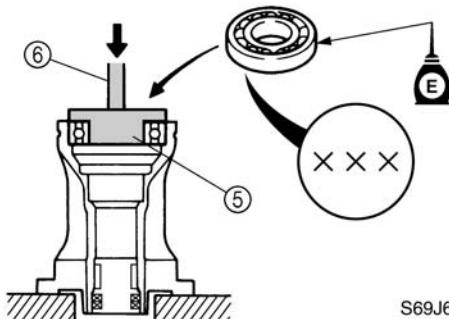


Oil seal installer ③: YB-06195  
Driver handle ④: YB-06071



Depth ④:  
4.75–5.25 mm (0.187–0.207 in)

3. Install the ball bearing into the propeller shaft housing.



S69J6155

**NOTE:**

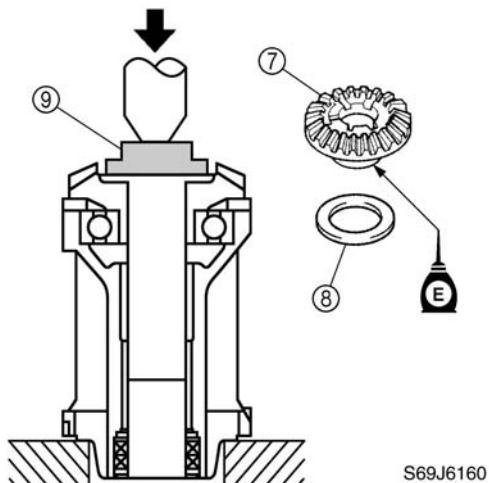
Install the ball bearing with the manufacture identification mark facing toward the propeller shaft housing.



Forward bearing installer ⑤:  
YB-06430  
Driver handle ⑥: YB-06071

## Propeller shaft housing (regular rotation model)

4. Install the reverse gear ⑦ and original shim(s) ⑧ to the propeller shaft housing using a press.

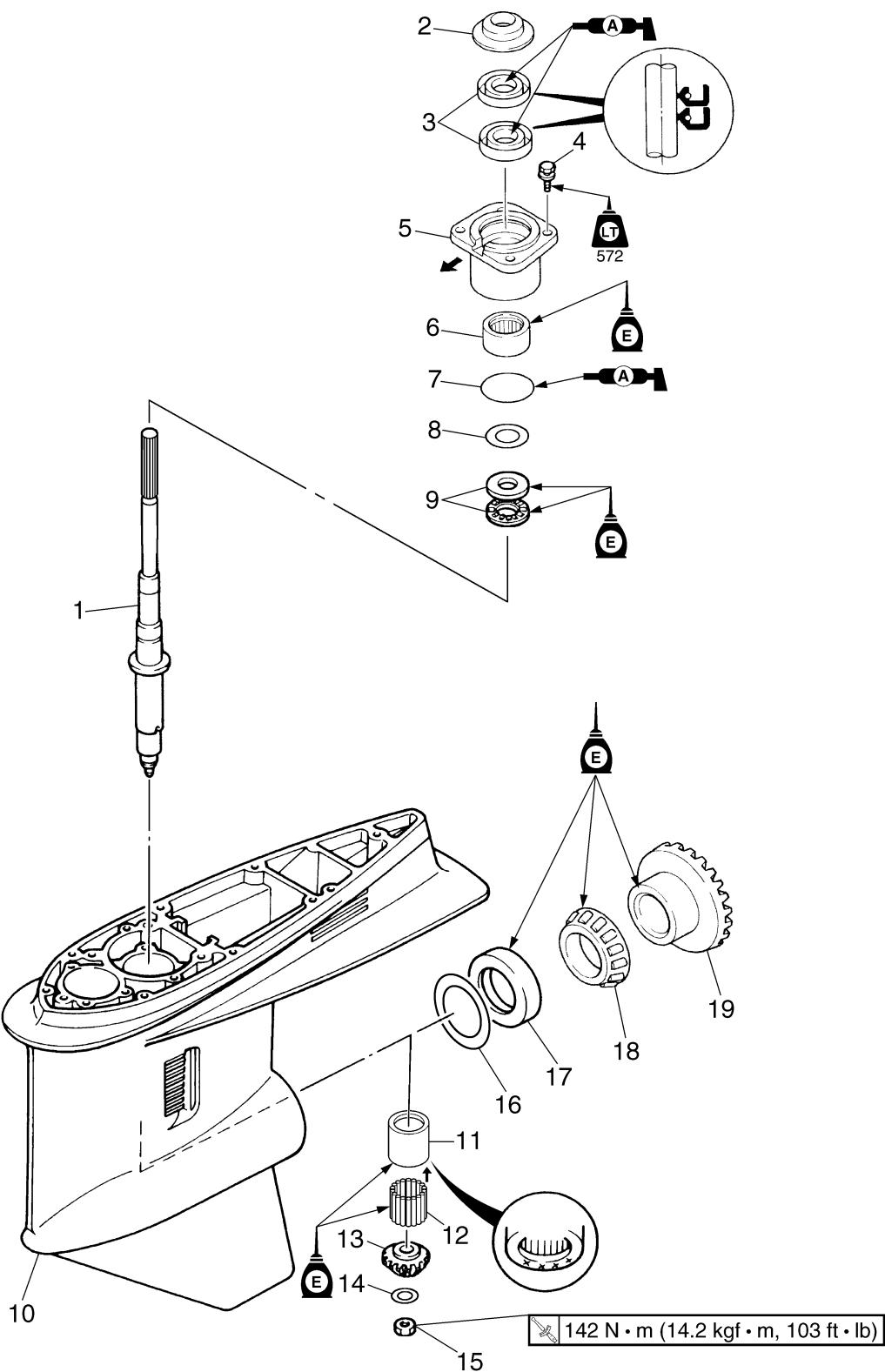


### CAUTION:

Add or remove shim(s), if necessary, when replacing the reverse gear or ball bearing.



Bearing outer race attachment ⑨:  
YB-06109

**LOWR****Lower unit****Drive shaft and lower case (regular rotation model)**

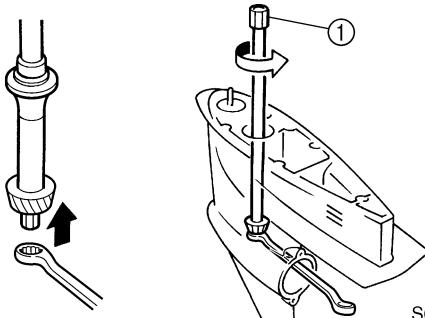
S69J6170

## Drive shaft and lower case (regular rotation model)

No.	Part name	Q'ty	Remarks
1	Drive shaft	1	
2	Cover	1	
3	Oil seal	2	<b>Not reusable</b>
4	Bolt	4	M8 × 25 mm
5	Drive shaft housing	1	
6	Needle bearing	1	
7	O-ring	1	<b>Not reusable</b> 3 × 60.5 mm
8	Pinion shim	—	As required
9	Thrust bearing	1	
10	Lower case	1	
11	Needle bearing outer case	1	
12	Needle bearing	24	
13	Pinion	1	
14	Washer	1	
15	Nut	1	
16	Forward gear shim	—	As required
17	Bearing outer race	1	<b>Not reusable</b>
18	Taper roller bearing	1	<b>Not reusable</b>
19	Forward gear	1	

**LOWR****Lower unit****Removing the drive shaft**

1. Remove the drive shaft, drive shaft housing, and pinion, and then pull out the forward gear.



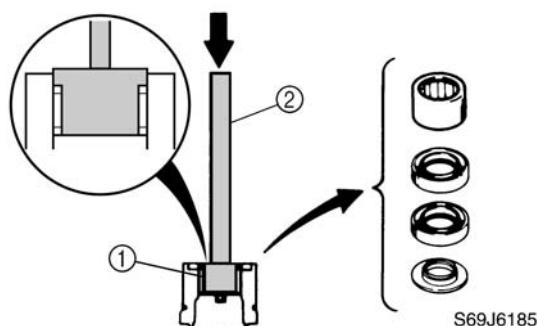
S69J6175



Drive shaft holder ①: YB-06201

**Disassembling the drive shaft housing**

1. Remove the cover, oil seals, and needle bearing.



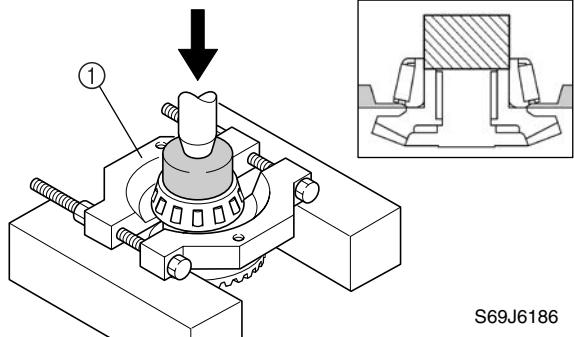
S69J6185

Drive shaft needle bearing remover and installer ①:  
YB-06196

Driver handle ②: YB-06071

**Disassembling the forward gear**

1. Remove the taper roller bearing from the forward gear using a press.



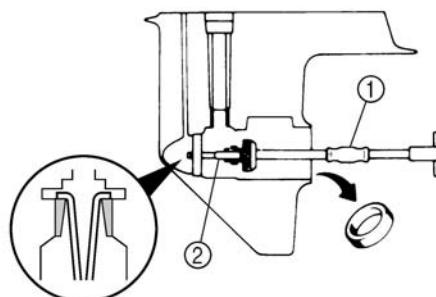
S69J6186

**CAUTION:**

**Do not reuse the bearing, always replace it with a new one.**

Bearing splitter plate ①:  
(commercially obtainable)**Disassembling the lower case**

1. Remove the taper roller bearing outer race and shim(s).



S69J6187

**NOTE:**

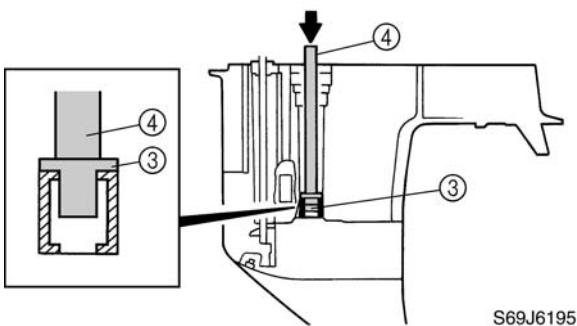
Install the claws as shown.

Slide hammer and adapters ①:  
YB-06096

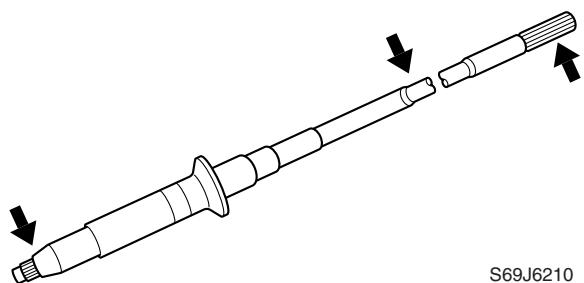
Puller claw ②: YB-06523

2. Remove the needle bearing.

## Drive shaft and lower case (regular rotation model)

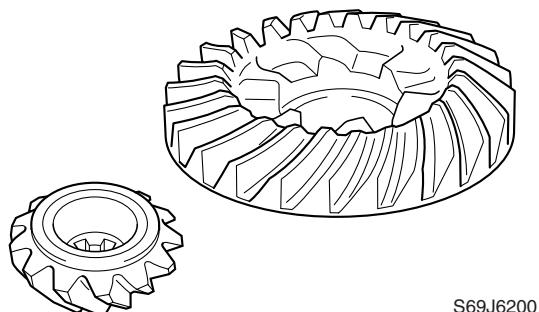


 Roller bearing installer/remover ③:  
YB-06432  
Driver handle ④: YB-06071



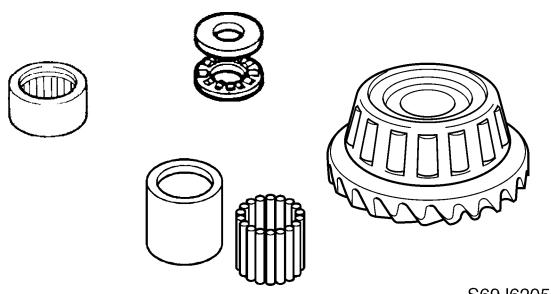
### Checking the pinion and forward gear

1. Check the teeth of the pinion, and the teeth and dogs of the forward gear for cracks or wear. Replace if necessary.



### Checking the bearings

1. Check the bearings for pitting or rumbling. Replace if necessary.

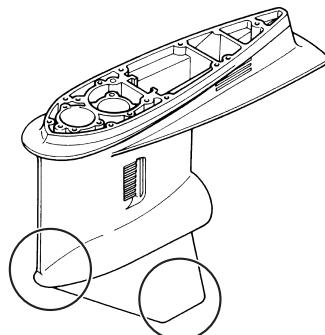


### Checking the drive shaft

1. Check the drive shaft for bends or wear. Replace if necessary.

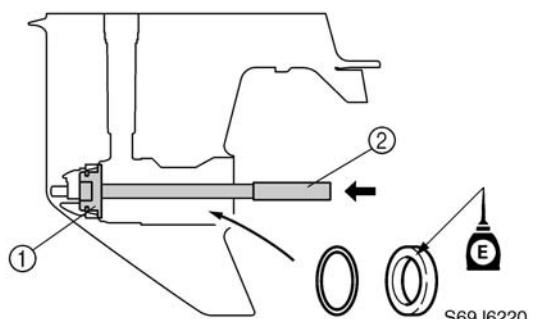
### Checking the lower case

1. Check the skeg and torpedo for cracks or damage. Replace if necessary.



### Assembling the lower case

1. Install the original shim(s) and taper roller bearing outer race.



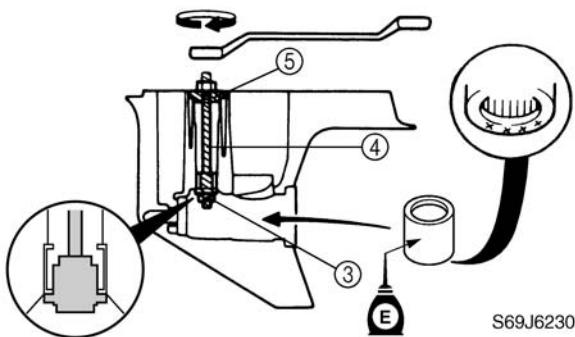
#### CAUTION:

Add or remove shim(s), if necessary, when replacing the forward gear or lower case.

 Taper roller bearing installer ①:  
YB-06431  
Driver handle ②: YB-06071

**LOWR****Lower unit**

- Install the needle bearing outer case into the lower case.

**NOTE:**

Apply engine oil to the needle bearing outer case before installation.

	Needle bearing installer ③: YB-06435
	Pinion gear bushing installer ④: YB-06029-4
	Needle bearing remover and installer ⑤: YB-06213

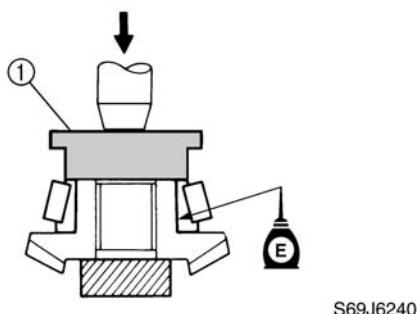
- Install the needle bearing into the needle bearing outer case.

**NOTE:**

Apply engine oil or grease to the needle bearing, and then install it.

**Assembling the forward gear**

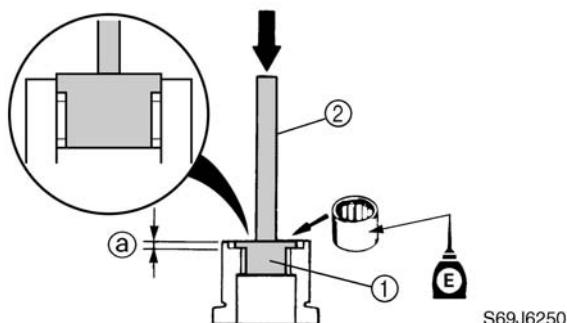
- Install the new taper roller bearing into the forward gear using a press.



	Forward gear bearing cup installer ①: YB-06276-B
--	--

**Assembling the drive shaft housing**

- Install the needle bearing into the drive shaft housing to the specified depth.

**Needle bearing installer and remover**

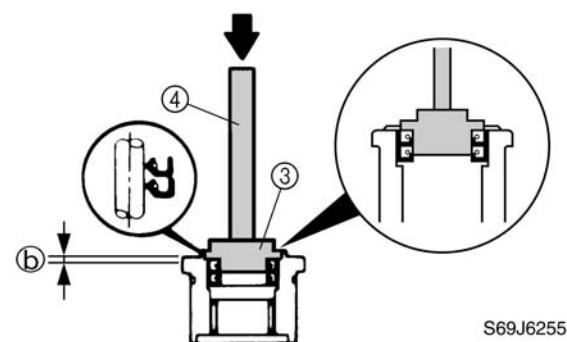
①:

YB-06194

Driver handle ②: YB-06071

	Depth ③: 4.25–4.75 mm (0.167–0.187 in)
--	---

- Apply grease to the new oil seals, and then install them into the drive shaft housing to the specified depth.

**NOTE:**

Install an oil seal halfway into the drive shaft housing, then the other oil seal.

	Oil seal installer ③: YB-06195
	Driver handle ④: YB-06071

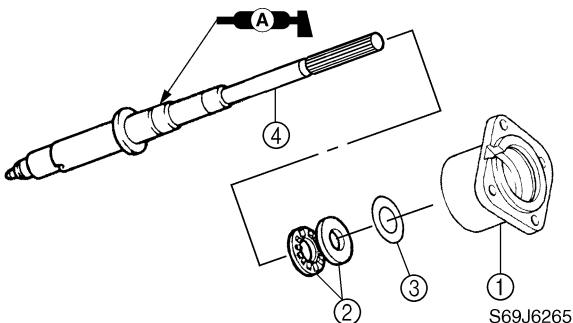
	Depth ⑤: 0.25–0.75 mm (0.01–0.03 in)
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**Installing the drive shaft**

- Install the forward gear to the lower case.

## Drive shaft and lower case (regular rotation model)

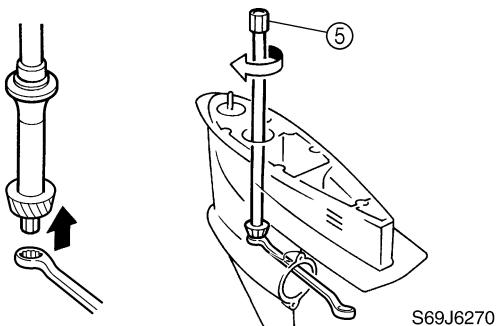
2. Install the drive shaft housing ①, thrust bearing ②, and original shim(s) ③ to the drive shaft ④.



**CAUTION:**

Add or remove shim(s), if necessary, when replacing the drive shaft housing or drive shaft.

3. Install the drive shaft and drive shaft housing to the lower case, then the pinion and pinion nut, and then tighten the nut to the specified torque.



**NOTE:**

Install the drive shaft by lifting it up slightly, then aligning it with the pinion and the spline of the drive shaft.



Drive shaft holder ⑤: YB-06201

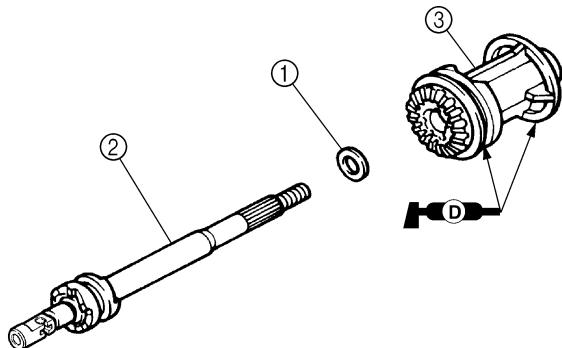


Pinion nut:  
142 N·m (14.2 kgf·m, 103 ft·lb)

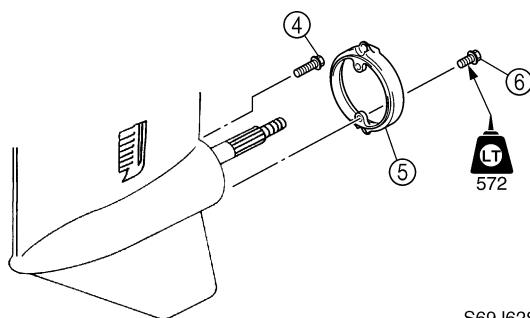
4. Tighten the drive shaft housing bolts.

### Installing the propeller shaft housing

1. Install the washer ① and propeller shaft assembly ② into the propeller shaft housing assembly ③.
2. Apply grease to the new O-rings.



3. Install the propeller shaft housing assembly into the lower case.
4. Install the bolts ④, ring ⑤, and bolts ⑥, and then tighten the bolts ④ to the specified torque.

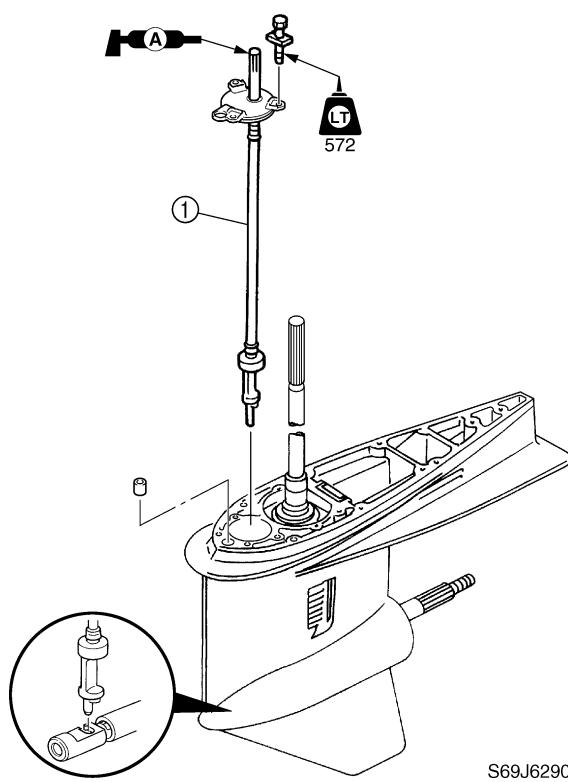


Propeller shaft housing bolt ④:  
30 N·m (3.0 kgf·m, 22 ft·lb)

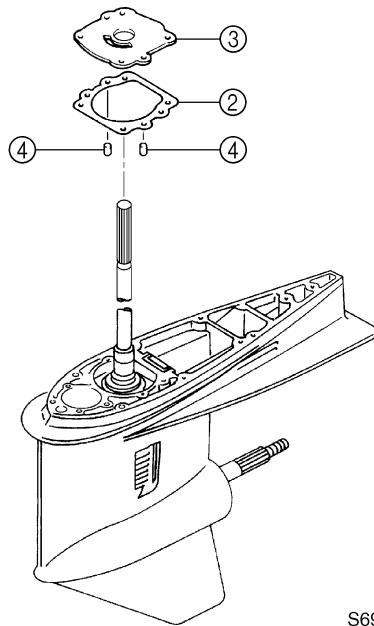
6

### Installing the water pump and shift rod

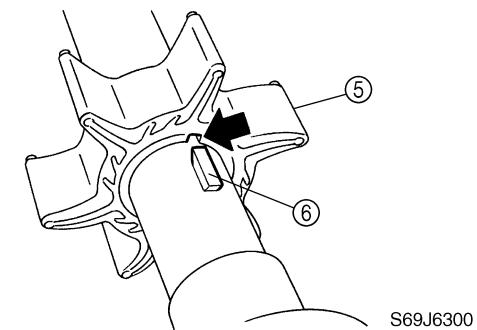
1. Install the shift rod assembly ①.

**LOWR****Lower unit**

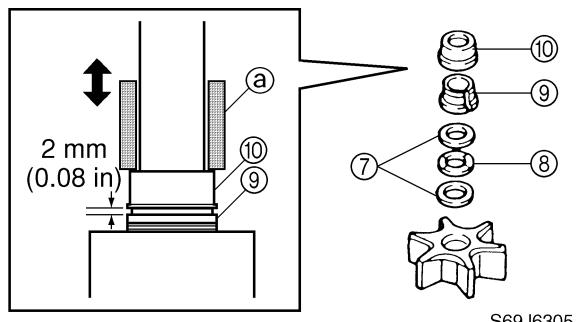
- Install the new gasket (2), outer plate cartridge (3), and dowel pins (4).



- Install the Woodruff key into the drive shaft.
- Align the groove on the impeller (5) with the Woodruff key (6), and then install it to the drive shaft.

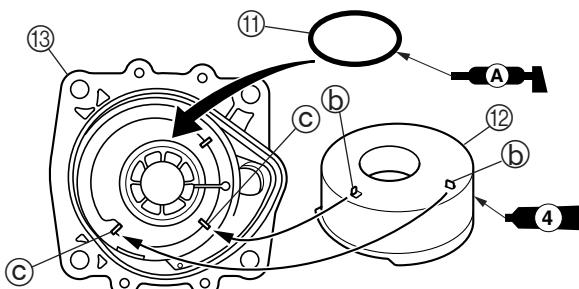


- Install the washers (7), wave washer (8), spacer (9), and collar (10) to the drive shaft.

**NOTE:**

- The collar and spacer should fit together firmly.
- While pulling the drive shaft up, install the collar with an appropriate tool (a) that fits over the drive shaft as shown.

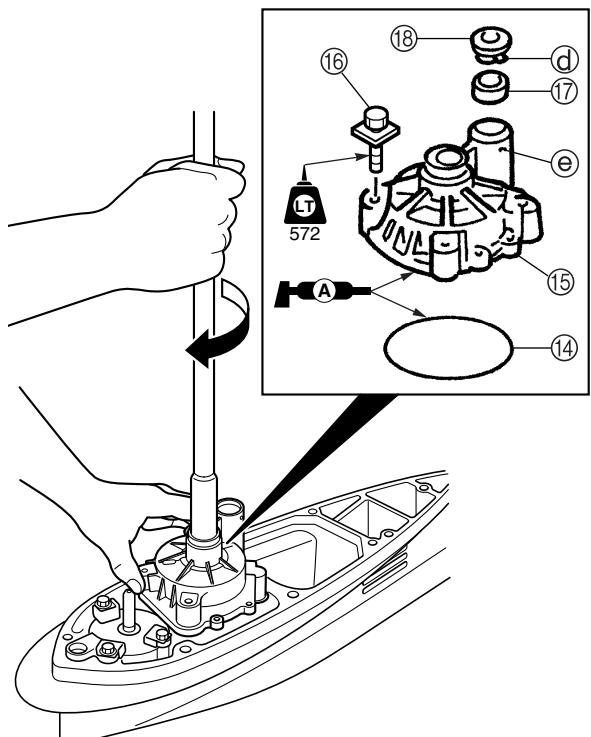
- Install the O-ring (11) and insert cartridge (12) into the pump housing (13).

**NOTE:**

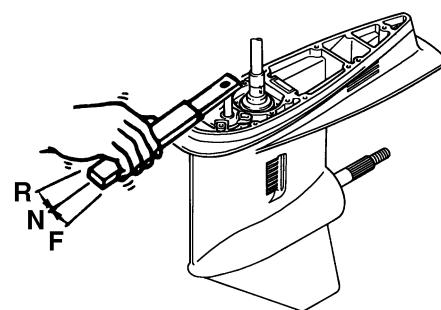
- Align the insert cartridge projections (b) with the holes (c) in the pump housing.

## Drive shaft and lower case (regular rotation model)

7. Install the O-ring ⑯ and pump housing assembly ⑮ into the lower case, tighten the bolts ⑯, and then install the seal ⑰ and cover ⑱.



S69J6315



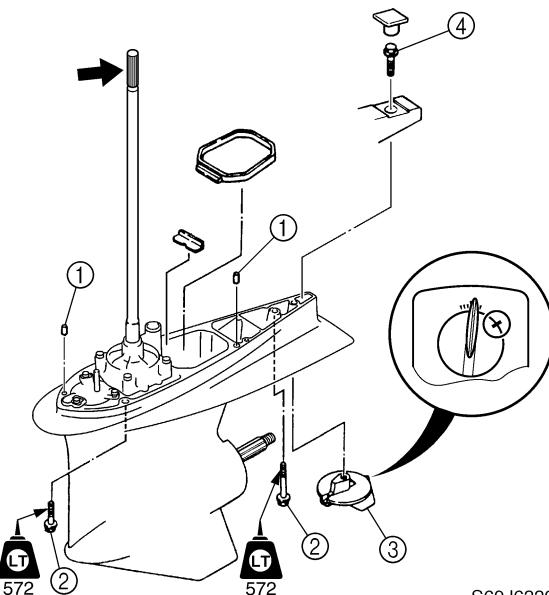
S69J6630



Shift rod push arm: YB-06052

2. Install the two dowel pins ① to the lower unit.
3. Install the lower unit to the upper case, and then tighten the bolts ② to the specified torque.
4. Install the trim tab ③ to its original position, and then tighten the bolt ④ to the specified torque.

**6**



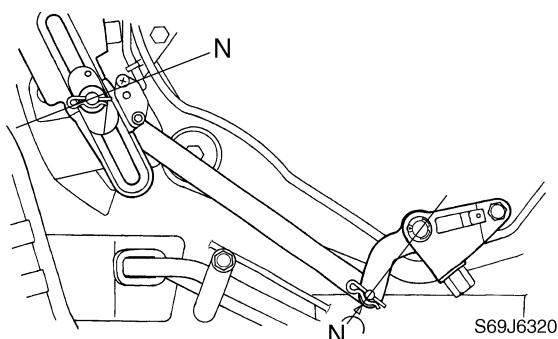
S69J6330



Lower case bolts ②:  
47 N·m (4.7 kgf·m, 34 ft·lb)  
Trim tab bolt ④:  
43 N·m (4.3 kgf·m, 31 ft·lb)

### Installing the lower unit

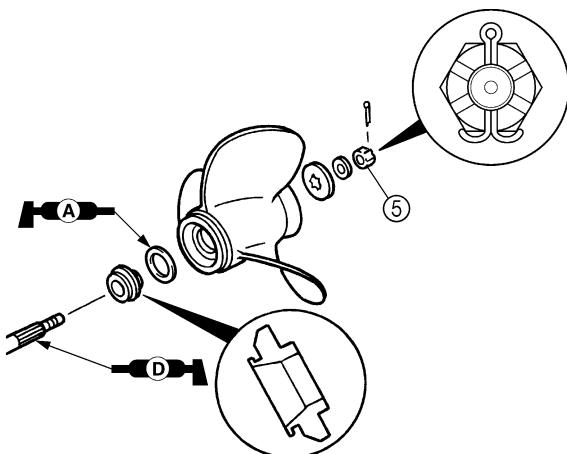
1. Set the gearshift to the neutral position at the lower unit.



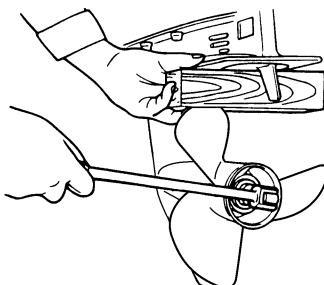
S69J6320

**LOWR****Lower unit**

5. Install the propeller and propeller nut, and then tighten the nut finger tight. Place a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning, and then tighten the nut to the specified torque.



S69J6335



S69J6340

**⚠ WARNING**

**Do not hold the propeller with your hands when loosening or tightening it. Be sure to disconnect the battery cables from the batteries and the engine stop lanyard switch. Put a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning.**

**NOTE:**

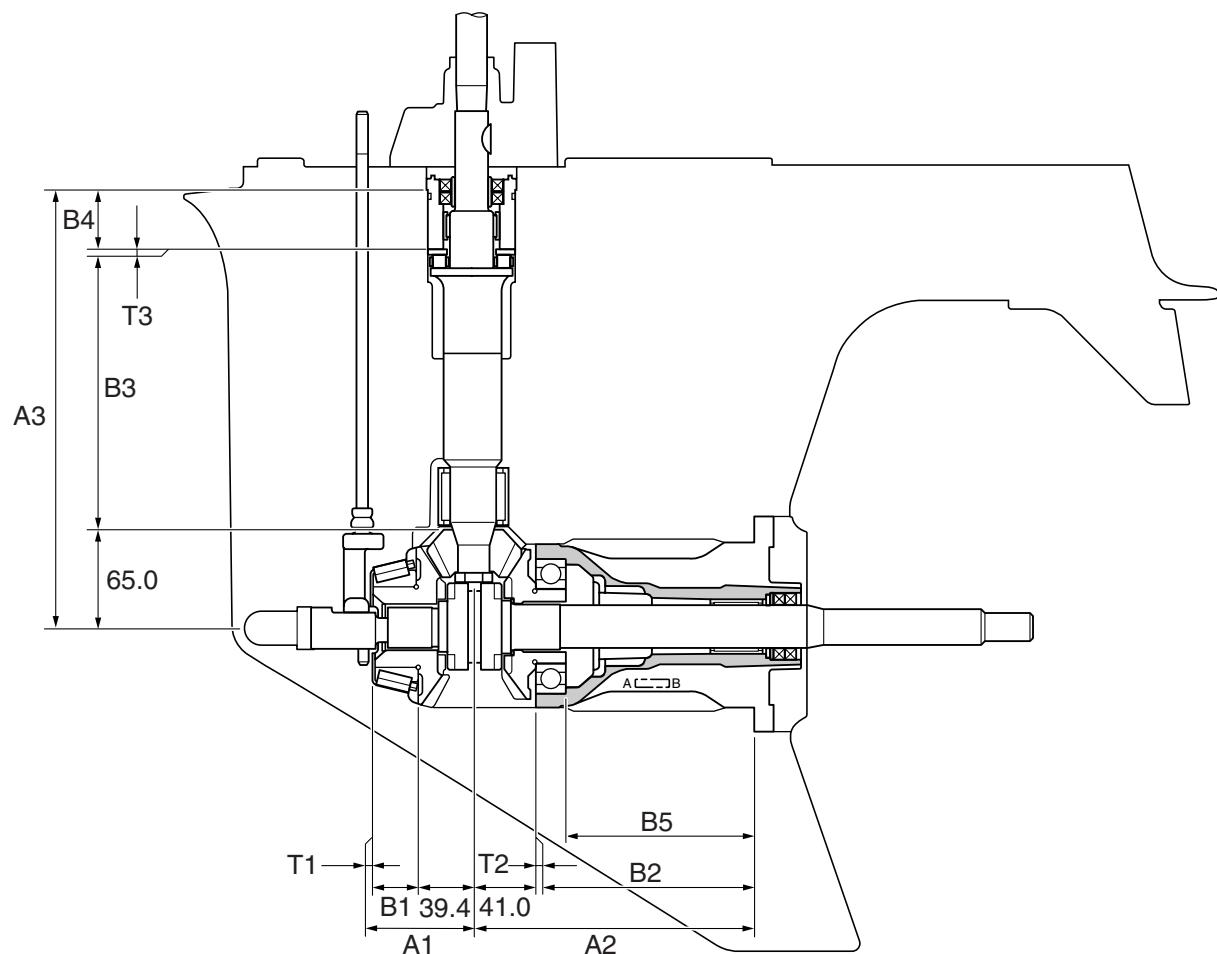
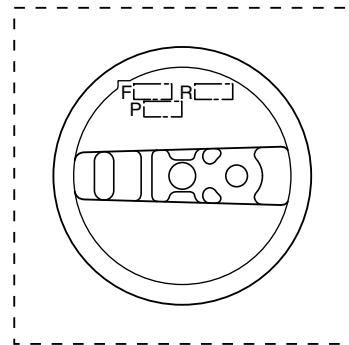
If the grooves in the propeller nut (5) do not align with the cotter pin hole, tighten the nut until they are aligned.



Propeller nut (5):  
55 N·m (5.5 kgf·m, 40 ft·lb)

## **Drive shaft and lower case (regular rotation model) / Shimming (regular rotation model)**

### **Shimming (regular rotation model)**



**6**

S69J6550

**LOWR****Lower unit**

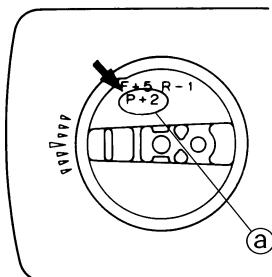
## Shimming

**NOTE:**

- Shimming is not required when assembling the original lower case and inner parts.
- Shimming is required when assembling the original inner parts and a new lower case.
- Shimming is required when replacing the inner part(s).

## Selecting the pinion shims

1. Calculate the specified value ( $M_0$ ) as shown in the examples below.



S69J6555

**NOTE:**

“P” is the deviation of the lower case dimension from standard. The “P” mark (a) is stamped on the trim tab mounting surface of the lower case in 0.01 mm units. If the “P” mark is unreadable, assume that “P” is zero and check the backlash when the unit is assembled.

**Calculation formula:**

$$\text{Specified value } (M_0) = 1.00 + P/100 \text{ mm}$$

**Example:**

If “P” is (+5), then

$$M_0 = 1.00 + (+5)/100 \text{ mm} = 1.00 + 0.05 \text{ mm} \\ = 1.05 \text{ mm}$$

If “P” is (-3), then

$$M_0 = 1.00 + (-3)/100 \text{ mm} = 1.00 - 0.03 \text{ mm} \\ = 0.97 \text{ mm}$$

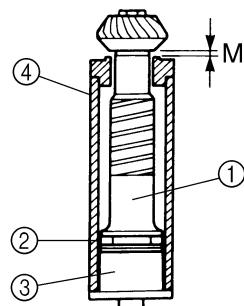
2. Install the drive shaft ①, thrust bearing ②, and drive shaft housing ③ to the shimming tool.

3. Install the pinion and pinion nut, and then tighten the nut to the specified torque.


**Pinion shimming gauge III ④:**  
YB-06441

**Pinion nut:**  
142 N·m (14.2 kgf·m, 103 ft·lb)

4. Measure the clearance (M) between the shimming tool and the pinion as shown.

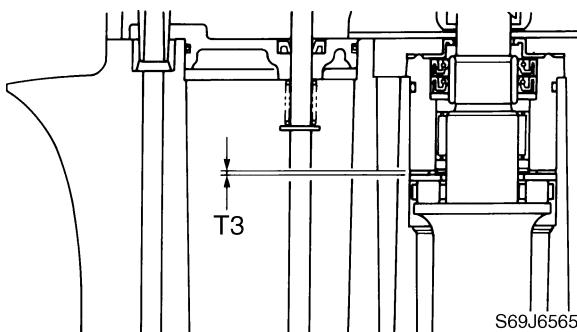


S69J6560

**NOTE:**

Measure the pinion at three points to find the clearance average.

5. Select the pinion shim(s) (T3).



S69J6565

**NOTE:**

The sum of T3 and M should not be more than  $M_0$ .

**Calculation formula:**

$$\text{Pinion shim thickness } (T3) = M_0 - M$$

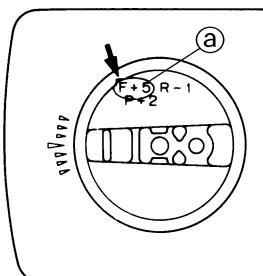
**Available shim thicknesses:**

0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and  
0.50 mm

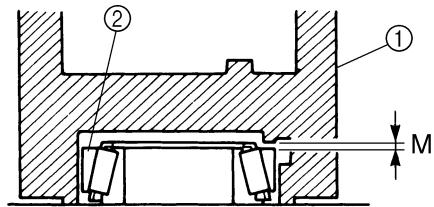
## Shimming (regular rotation model)

### Selecting the forward gear shims

- Calculate the specified value ( $M_0$ ) as shown in the examples below.



S69J6570



S69J6575

**NOTE:** \_\_\_\_\_  
“F” is the deviation of the lower case dimension from standard. The “F” mark **a** is stamped on the trim tab mounting surface of the lower case in 0.01 mm units. If the “F” mark is unreadable, assume that “F” is zero and check the backlash when the unit is assembled.

**Calculation formula:**  
Specified value ( $M_0$ ) =  $0.50 - F/100$  mm

**Example:**

If “F” is (+5), then

$$M_0 = 0.50 - (+5)/100 \text{ mm} = 0.50 - 0.05 \text{ mm} \\ = 0.45 \text{ mm}$$

If “F” is (-3), then

$$M_0 = 0.50 - (-3)/100 \text{ mm} = 0.50 + 0.03 \text{ mm} \\ = 0.53 \text{ mm}$$

- Set the shimming tool on the taper roller bearing.

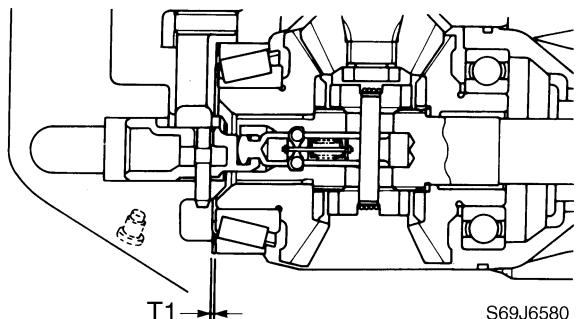


Shimming gauge I ①: YB-06439

- Measure the clearance (M) between the shimming tool and the bearing outer race ② as shown.

**NOTE:** \_\_\_\_\_  
Measure the taper roller bearing at three points to find the clearance average.

- Select the forward gear shim(s) (T1).



S69J6580

**NOTE:** \_\_\_\_\_  
The sum of T1 and  $M_0$  should not be more than M.

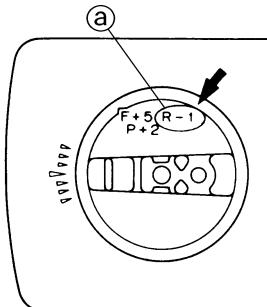
**Calculation formula:**  
Forward gear shim thickness (T1) =  $M - M_0$

**Available shim thicknesses:**  
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

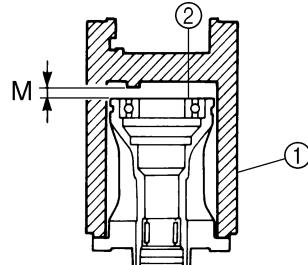
6

**LOWR****Lower unit****Selecting the reverse gear shims**

- Calculate the specified value ( $M_0$ ) as shown in the examples below.



S69J6585



S69J6590

**NOTE:**

"R" is the deviation of the lower case dimension from standard. The "R" mark ② is stamped on the trim tab mounting surface of the lower case in 0.01 mm units. If the "R" mark is unreadable, assume that "R" is zero and check the backlash when the unit is assembled.

**Calculation formula:**

$$\text{Specified value } (M_0) = 0.50 - R/100 \text{ mm}$$

**Example:**

If "R" is (+5), then

$$M_0 = 0.50 - (+5)/100 \text{ mm} = 0.50 - 0.05 \text{ mm} \\ = 0.45 \text{ mm}$$

If "R" is (-3), then

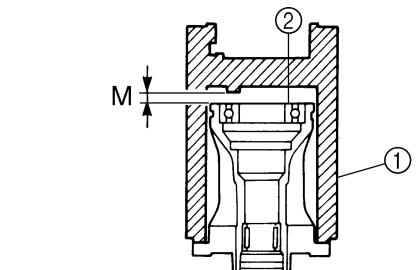
$$M_0 = 0.50 - (-3)/100 \text{ mm} = 0.50 + 0.03 \text{ mm} \\ = 0.53 \text{ mm}$$

- Set the shimming tool on the ball bearing.



Shimming gauge I ①: YB-06439

- Measure the clearance (M) between the shimming tool and the ball bearing ② as shown.

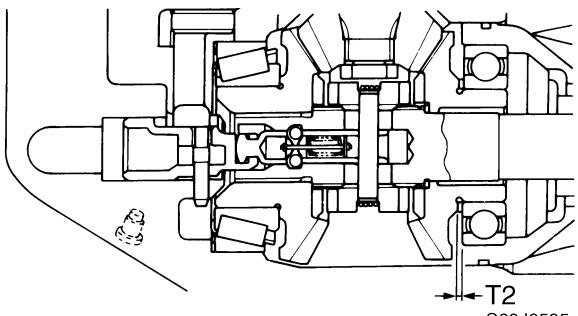


S69J6590

**NOTE:**

Measure the ball bearing at three points to find the clearance average.

- Select the reverse gear shim(s) (T2).



S69J6595

**NOTE:**

The sum of T2 and  $M_0$  should not be more than M.

**Calculation formula:**

$$\text{Reverse gear shim thickness } (T_2) = \\ M - M_0$$

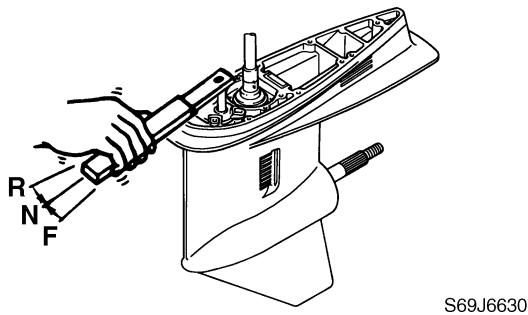
**Available shim thicknesses:**

0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and  
0.50 mm

## Shimming (regular rotation model) / Backlash (regular rotation model)

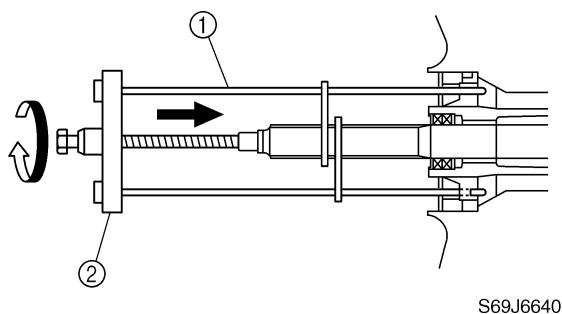
### Backlash (regular rotation model) Measuring the forward and reverse gear backlash

1. Remove the water pump assembly.
2. Set the gearshift to the neutral position.



Shift rod push arm: YB-06052

3. Install the special service tool so that it pushes against the propeller shaft.

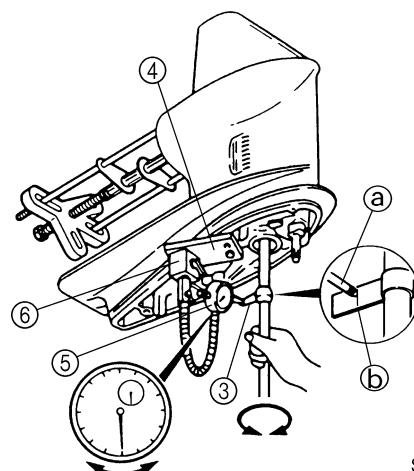


**NOTE:**  
Tighten the universal puller or center bolt while turning the drive shaft until the drive shaft can no longer be turned.



Bearing housing puller ①: YB-06207  
Universal puller ②: YB-06117

4. Install the backlash indicator onto the drive shaft (22.4 mm [0.88 in] in diameter), then the dial gauge onto the lower unit.
5. Set the lower unit upside down.



S69J6650

**NOTE:**  
Install the dial gauge so that the plunger ① contacts the mark ② on the backlash indicator.



Backlash indicator gauge ③:  
YB-06265

Magnetic plate ④: YB-07003

Dial gauge ⑤: YU-03097

Magnet flexible stand ⑥: YU-34481

6. Slowly turn the drive shaft clockwise and counterclockwise and measure the backlash when the drive shaft stops in each direction.



Forward gear backlash:  
0.21–0.44 mm (0.008–0.017 in)

7. Add or remove shim(s) if out of specification.

Forward gear backlash	Shim thickness
Less than 0.21 mm (0.008 in)	To be decreased by $(0.33 - M) \times 0.71$
More than 0.44 mm (0.017 in)	To be increased by $(M - 0.33) \times 0.71$

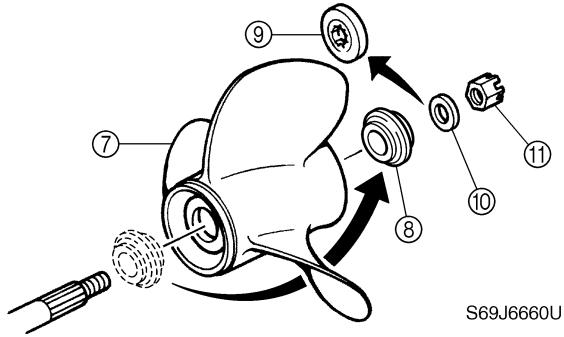
M: Measurement

Available shim thicknesses:

0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

**LOWR****Lower unit**

8. Remove the special service tools from the propeller shaft.
9. Apply a load to the reverse gear by installing the propeller ⑦, the spacer ⑧ (without the washer ⑨), then the washer ⑩ as shown.

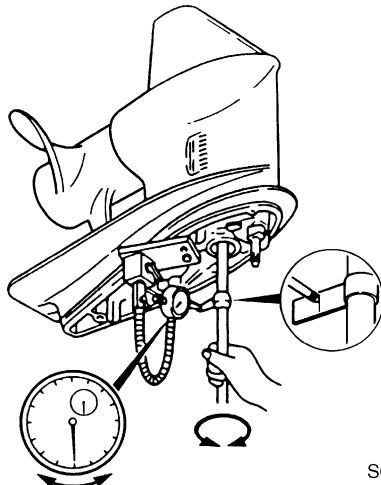


S69J6660U

**NOTE:**

Tighten the propeller nut ⑪ while turning the drive shaft until the drive shaft can no longer be turned.

10. Slowly turn the drive shaft clockwise and counterclockwise and measure the backlash when the drive shaft stops in each direction.



S69J6665



**Reverse gear backlash:**  
0.70–1.03 mm (0.028–0.041 in)

11. Add or remove shim(s) if out of specification.

Reverse gear backlash	Shim thickness
Less than 0.70 mm (0.028 in)	To be decreased by $(0.87 - M) \times 0.71$
More than 1.03 mm (0.041 in)	To be increased by $(M - 0.87) \times 0.71$

M: Measurement

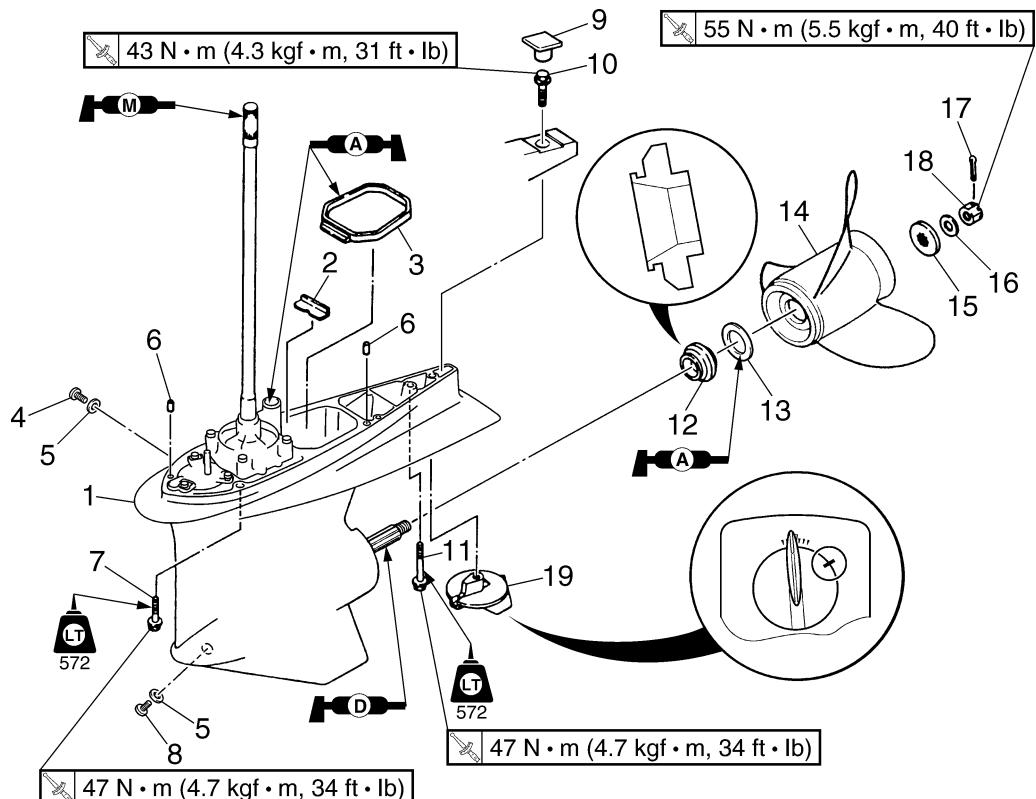
**Available shim thicknesses:**

0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

12. Remove the special service tools, and then install the water pump assembly.

## Backlash (regular rotation model) / Lower unit (counter rotation model)

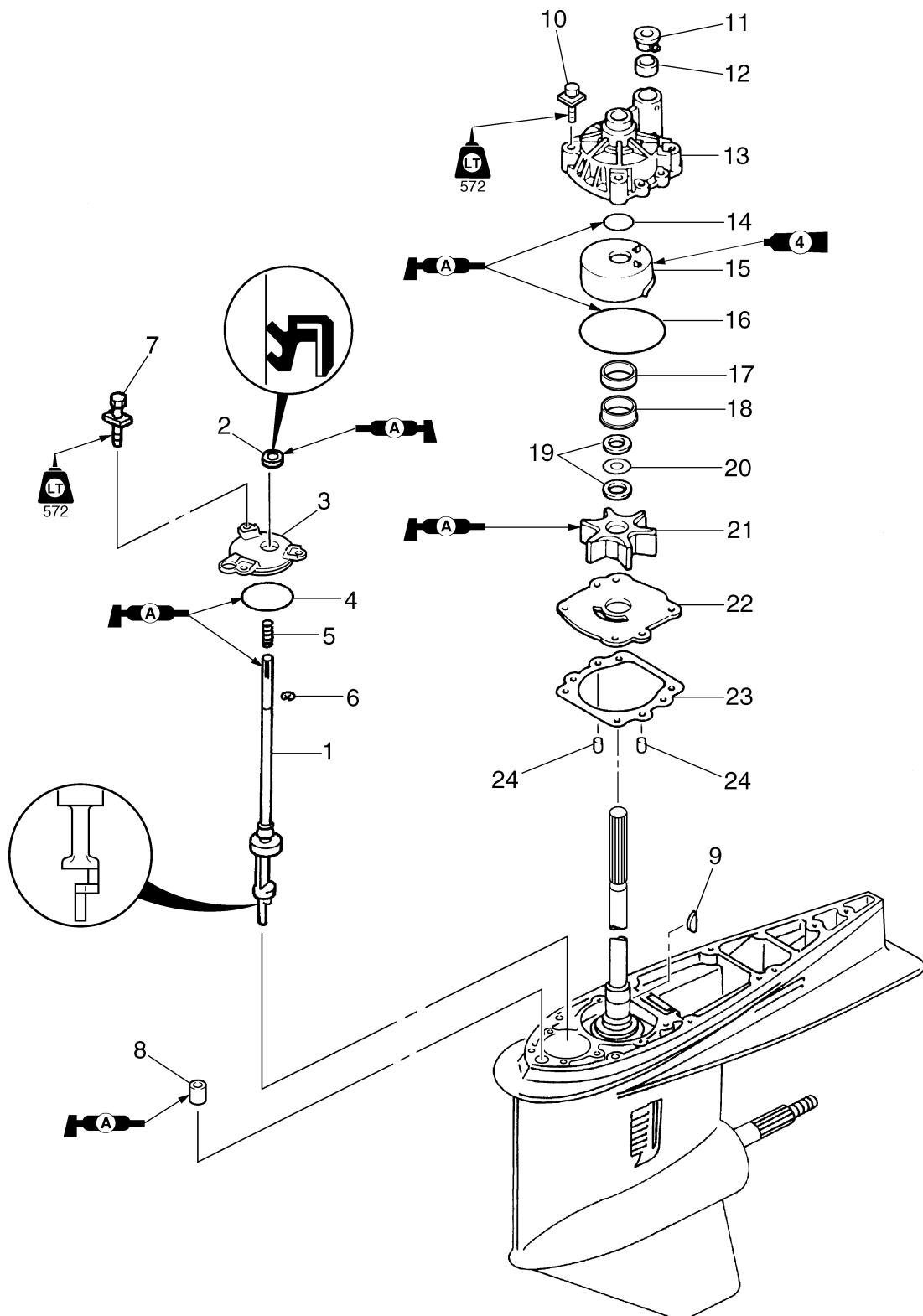
### Lower unit (counter rotation model)



S69J6345U

6

No.	Part name	Q'ty	Remarks
1	Lower unit	1	
2	Plate	1	
3	Rubber seal	1	
4	Check screw	1	
5	Gasket	2	<b>Not reusable</b>
6	Dowel pin	2	
7	Bolt	7	M10 × 45 mm
8	Drain screw	1	
9	Grommet	1	
10	Bolt	1	M10 × 44 mm
11	Bolt	1	M10 × 70 mm
12	Spacer	1	
13	Washer	1	
14	Propeller	1	
15	Washer	1	
16	Washer	1	
17	Cotter pin	1	<b>Not reusable</b>
18	Propeller nut	1	
19	Trim tab	1	

**LOWR****Lower unit**

S69J6350U

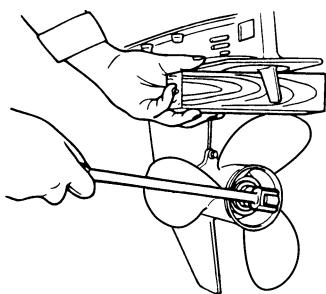
## Lower unit (counter rotation model)

No.	Part name	Q'ty	Remarks
1	Shift rod	1	
2	Oil seal	1	<b>Not reusable</b>
3	Oil seal housing	1	
4	O-ring	1	<b>Not reusable</b> 3.1 × 70.6 mm
5	Spring	1	
6	Circlip	1	
7	Bolt	3	M6 × 20 mm
8	Seal	1	
9	Woodruff key	1	
10	Bolt	4	M8 × 45 mm
11	Cover	1	
12	Seal	1	
13	Water pump housing	1	
14	O-ring	1	<b>Not reusable</b> 2.5 × 42 mm
15	Insert cartridge	1	
16	O-ring	1	<b>Not reusable</b> 2.5 × 91.5 mm
17	Collar	1	
18	Spacer	1	
19	Washer	2	
20	Wave washer	1	
21	Impeller	1	
22	Outer plate cartridge	1	
23	Gasket	1	<b>Not reusable</b>
24	Dowel pin	2	

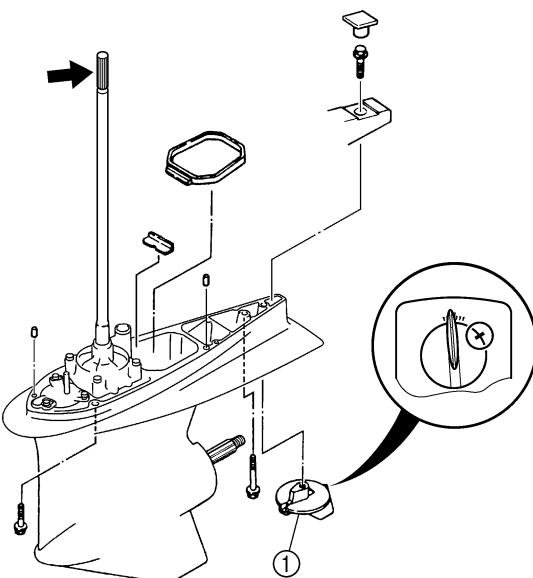
**LOWR****Lower unit**

### Removing the lower unit

1. Drain the gear oil. For draining procedures, see Chapter 3, "Changing the gear oil."
2. Set the gearshift to the neutral position, and place a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning, and then remove the propeller nut and propeller.



S69J6545



S69J6355

#### **WARNING**

**Do not hold the propeller with your hands when loosening or tightening it. Be sure to disconnect the battery cables from the batteries and the engine stop lanyard switch. Put a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning.**

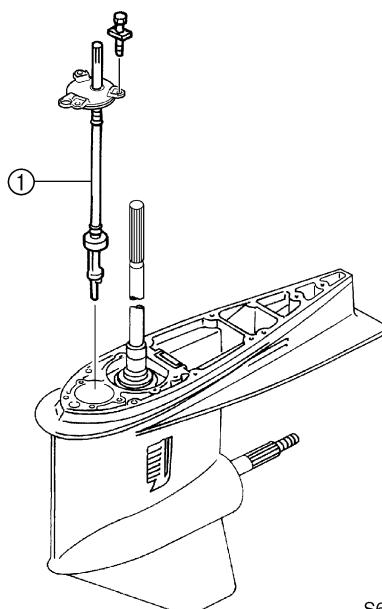
3. Mark the trim tab ① at the area shown, and then remove it.
4. Loosen the bolts, and then remove the lower unit from the upper case.

#### **NOTE:**

Check that there is no oil on the spline and check it for wear.

### Removing the water pump and shift rod

1. Remove the water pump assembly and shift rod assembly ①.

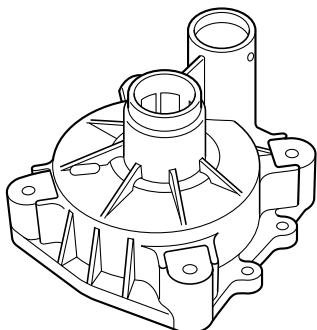


S69J6025

## Lower unit (counter rotation model)

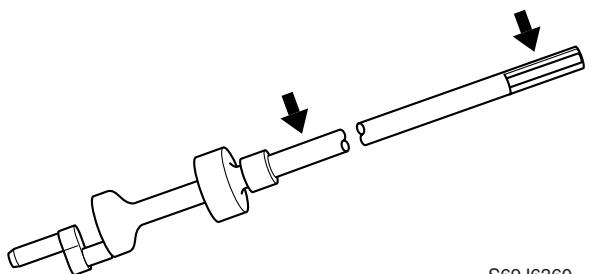
### Checking the water pump and shift rod

1. Check the water pump housing for deformation. Replace if necessary.



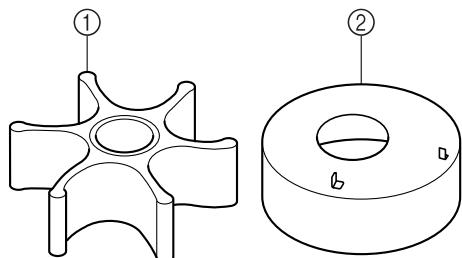
S69J6030

4. Check the shift rod for cracks or wear. Replace if necessary.



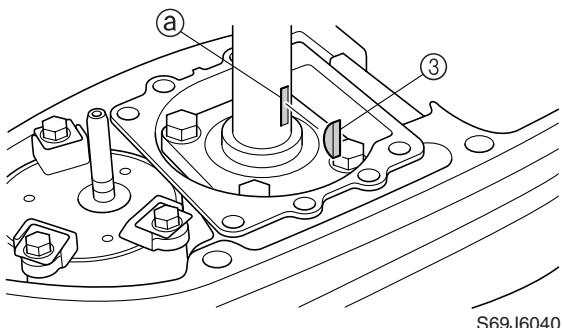
S69J6360

2. Check the impeller ① and insert cartridge ② for cracks or wear. Replace if necessary.



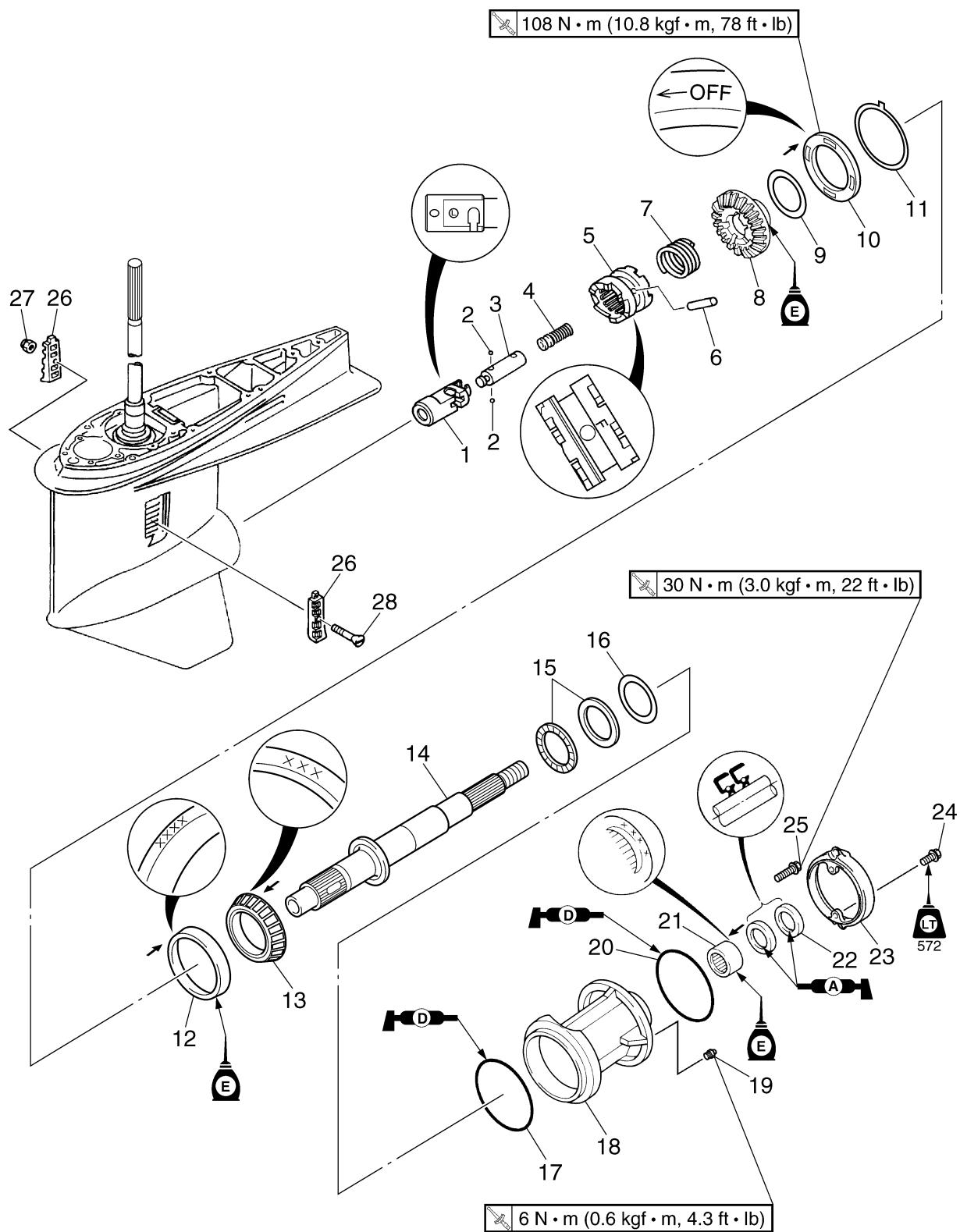
S69J6035

3. Check the Woodruff key ③ and the groove ④ on the drive shaft for wear. Replace if necessary.



S69J6040

6

**LOWR****Lower unit****Propeller shaft housing (counter rotation model)**

S69J6365

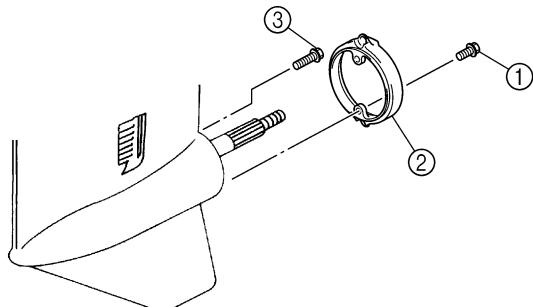
## Propeller shaft housing (counter rotation model)

No.	Part name	Q'ty	Remarks
1	Shift rod joint	1	
2	Ball	2	
3	Slider	1	
4	Shift plunger	1	
5	Dog clutch	1	
6	Cross pin	1	
7	Spring	1	
8	Forward gear	1	
9	Forward gear shim	—	As required
10	Ring nut	1	
11	Claw washer	1	
12	Bearing outer race	1	<b>Not reusable</b>
13	Taper roller bearing	1	<b>Not reusable</b>
14	Propeller shaft	1	
15	Thrust bearing	1	
16	Propeller shaft shim	—	As required
17	O-ring	1	<b>Not reusable</b> 3.1 × 110.6 mm
18	Propeller shaft housing	1	
19	Grease nipple	1	
20	O-ring	1	<b>Not reusable</b>
21	Needle bearing	1	
22	Oil seal	2	<b>Not reusable</b> 3.1 × 110.6 mm
23	Ring	1	
24	Bolt	2	M8 × 20 mm
25	Bolt	2	M8 × 30 mm
26	Cooling water inlet cover	2	
27	Nut	1	
28	Screw	1	

**LOWR****Lower unit**

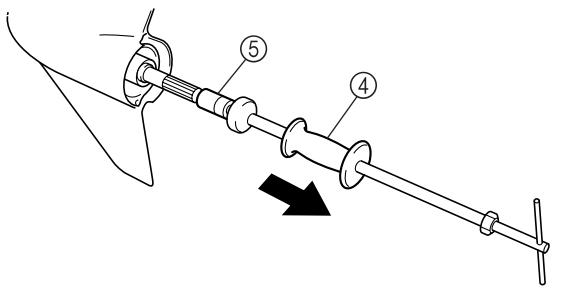
## Removing the propeller shaft housing assembly

1. Remove the bolts ①, ring ②, and bolts ③.



S69J6055

2. Pull out the propeller shaft housing assembly.



S69J6060

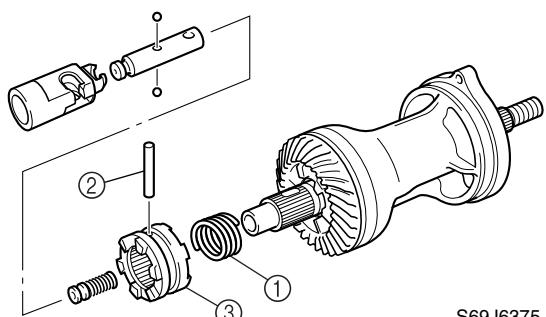


**Slide hammer and adapters ④:**  
YB-06096

**Propeller shaft and bearing housing remover ⑤:**  
YB-06335

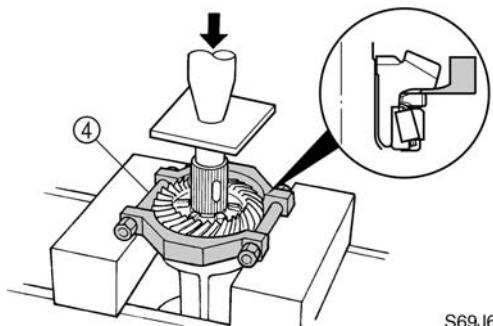
## Disassembling the propeller shaft housing

1. Remove the spring ①, and then remove the cross pin ②, dog clutch ③, slider shift plunger, and shift rod joint.



S69J6375

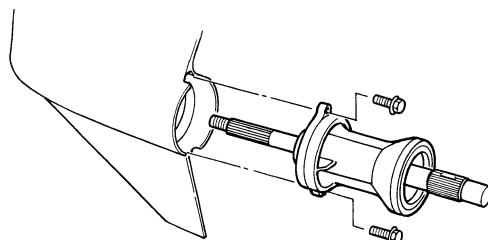
2. Remove the forward gear and forward gear shim(s) from the propeller shaft housing using a press.



S69J6380

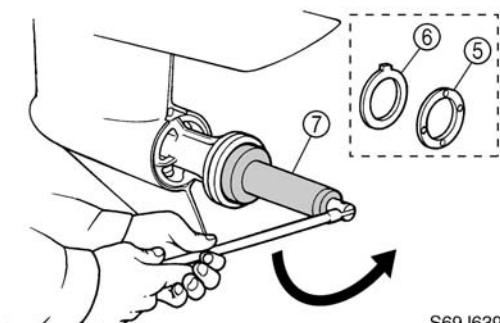
**Bearing splitter plate ④:**  
(commercially obtainable)

3. Install the propeller shaft assembly in the reverse direction into the lower case.



S69J6385

4. Remove the ring nut ⑤ and claw washer ⑥.

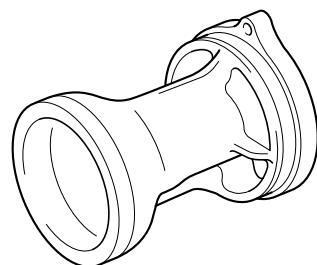
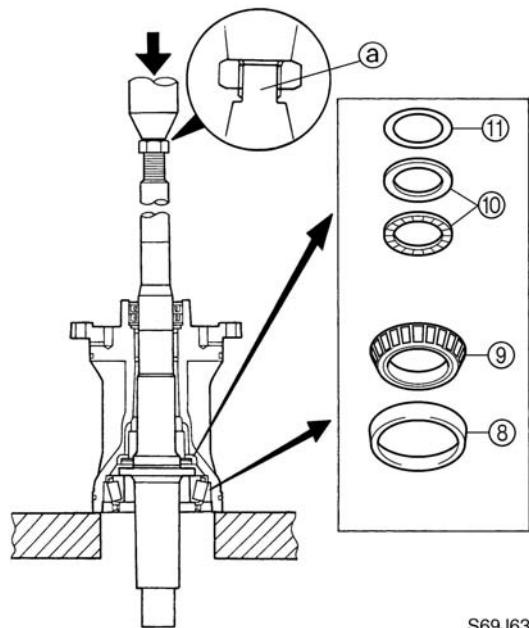


S69J6390

**Ring nut wrench ⑦:** YB-06578

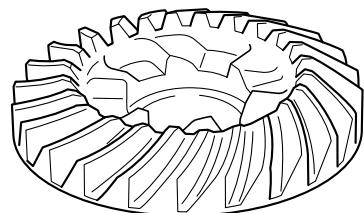
5. Remove the bearing outer race ⑧, taper roller bearing ⑨, thrust bearing ⑩, and propeller shaft shim(s) ⑪ using a press.

## Propeller shaft housing (counter rotation model)



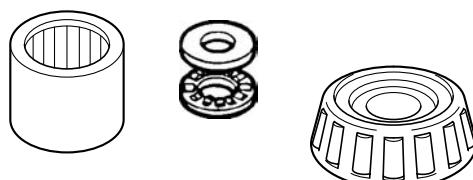
S69J6105

2. Check the teeth and dogs of the forward gear for cracks or wear. Replace the gear if necessary.



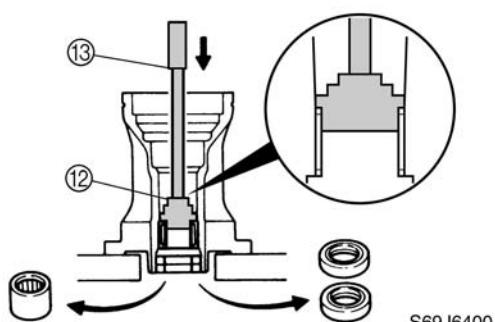
S69J6110

3. Check the bearings for pitting or rumbling. Replace if necessary.



S69J6410

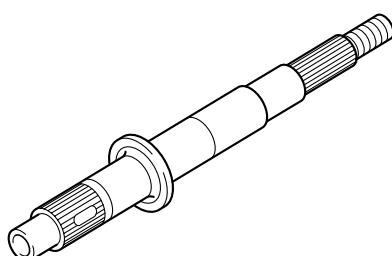
6



Oil seal installer ⑫: YB-06168  
Driver handle ⑬: YB-06071

### Checking the propeller shaft housing

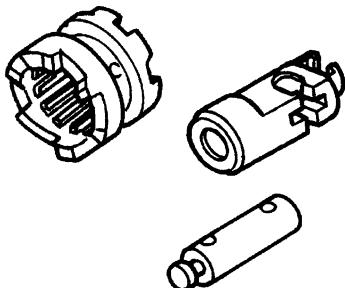
1. Clean the propeller shaft housing using a soft brush and cleaning solvent, and then check it for cracks. Replace if necessary.



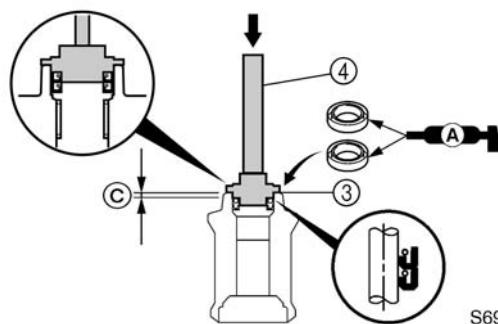
S69J6415

**LOWR****Lower unit**

- Check the dog clutch, shift rod joint, and shift slider for cracks or wear. Replace if necessary.



S69J6420



S69J6145

**NOTE:**

Install an oil seal halfway into the propeller shaft housing, then the other oil seal.



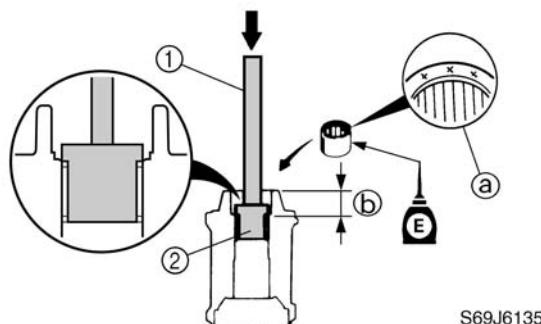
Oil seal installer (3): YB-06195

Driver handle (4): YB-06071



Depth (C):

4.75–5.25 mm (0.187–0.207 in)



S69J6135

**NOTE:**

Install the needle bearing with the manufacture identification mark (a) facing toward the oil seal (propeller side).



Driver handle (1): YB-06071

Drive shaft needle bearing remover and installer (2):

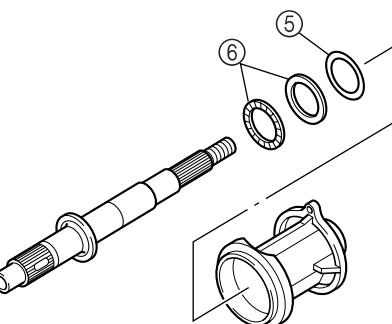
YB-06196



Depth (b):

25.05–25.55 mm (0.986–1.006 in)

- Apply grease to the new oil seals, and then install them into the propeller shaft housing to the specified depth.



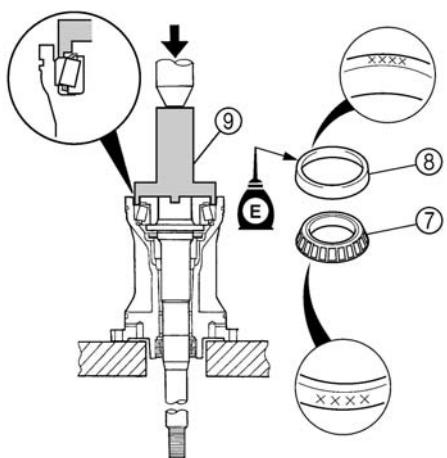
S69J6425

**CAUTION:**

Add or remove shim(s), if necessary, when replacing the propeller shaft, thrust bearing or propeller shaft housing.

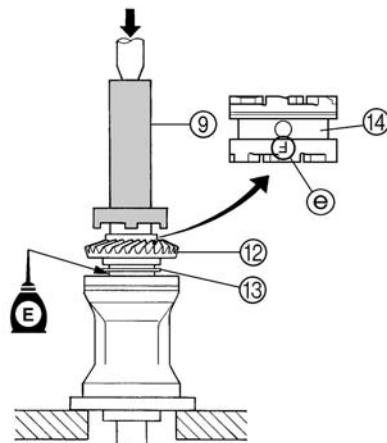
- Install the new taper roller bearing (7) and bearing outer race (8) into the propeller shaft housing using a press.

## Propeller shaft housing (counter rotation model)



Ring nut ⑩:  
108 N·m (10.8 kgf·m, 78 ft·lb)

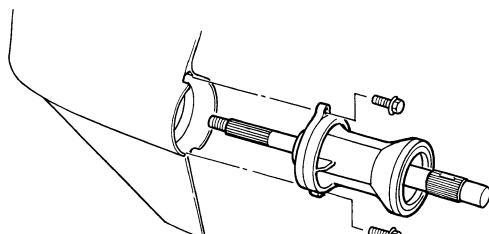
7. Install the forward gear ⑫, original shim(s) ⑬, and dog clutch ⑭ using a press.



S69J6440E

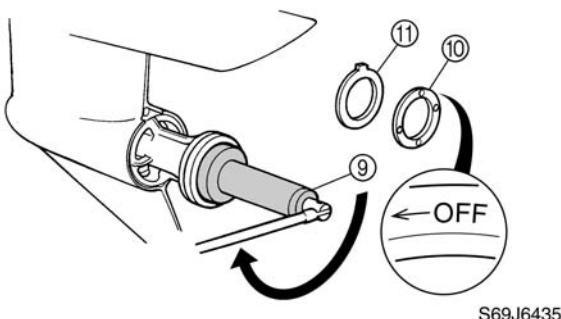
Ring nut wrench ⑨: YB-06578

5. Install the propeller shaft assembly in the reverse direction into the lower case.



S69J6385

6. Install the ring nut ⑩ and claw washer ⑪, and then tighten the ring nut to the specified torque.



S69J6435

Ring nut wrench ⑨: YB-06578

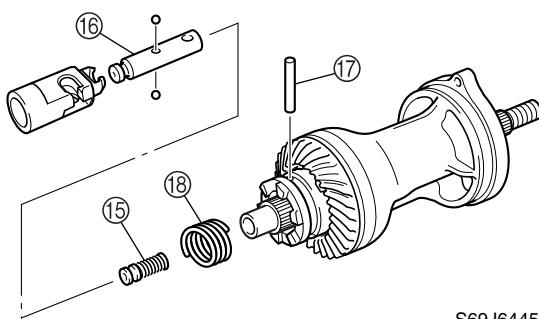
**NOTE:** \_\_\_\_\_  
Install the dog clutch ⑭ with the "F" mark ⑮ facing toward the forward gear.

**CAUTION:** \_\_\_\_\_  
**Add or remove shim(s), if necessary, when replacing the forward gear or taper roller bearing.**

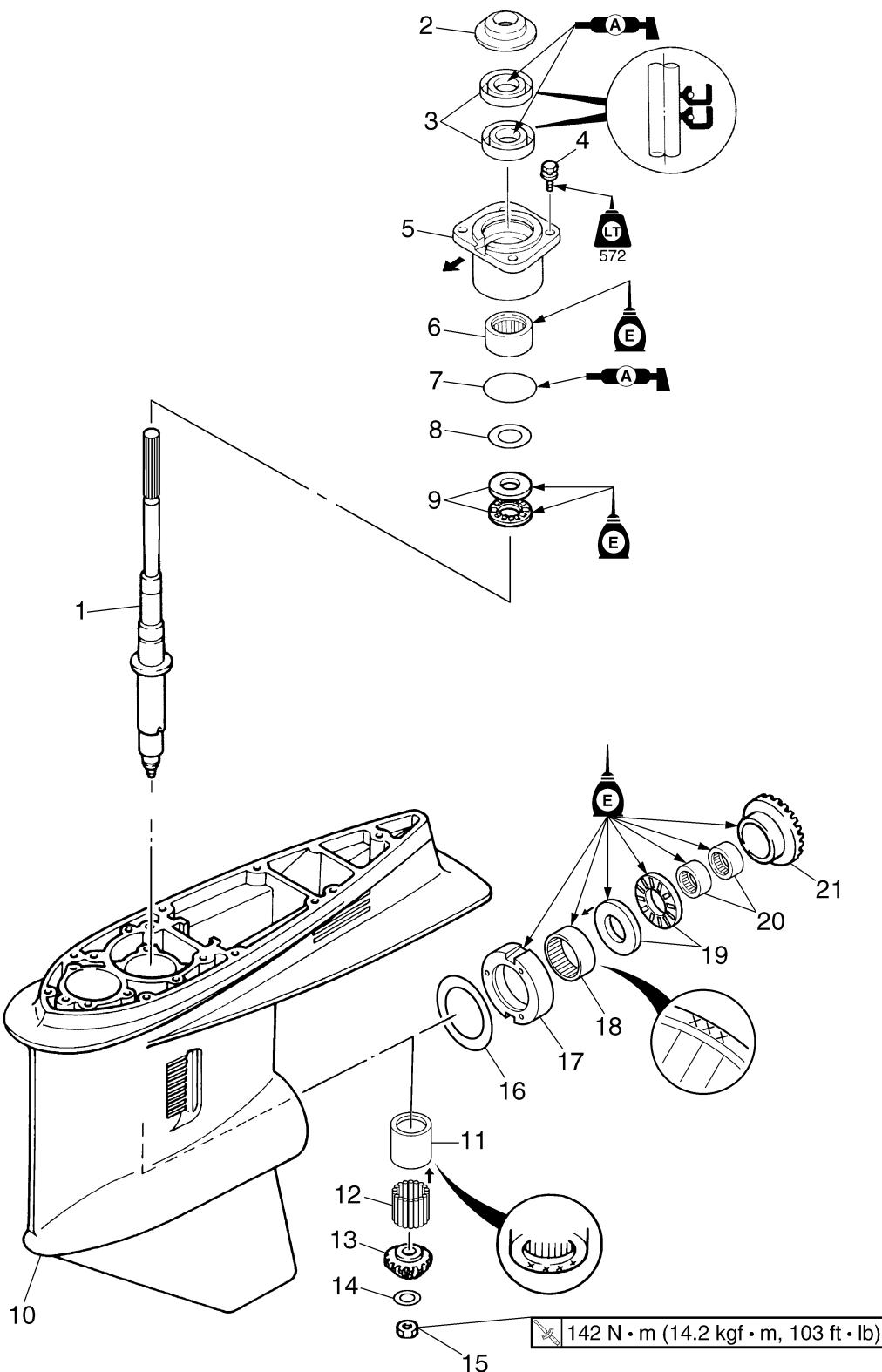
**6**

Ring nut wrench ⑨: YB-06578

8. Install the shift plunger ⑯ and slider ⑯ into the propeller shaft, and then install the cross pin ⑰ and spring ⑱.



S69J6445

**LOWR****Lower unit****Drive shaft and lower case (counter rotation model)**

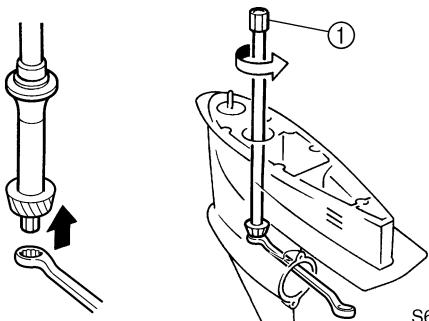
S69J6450

## Drive shaft and lower case (counter rotation model)

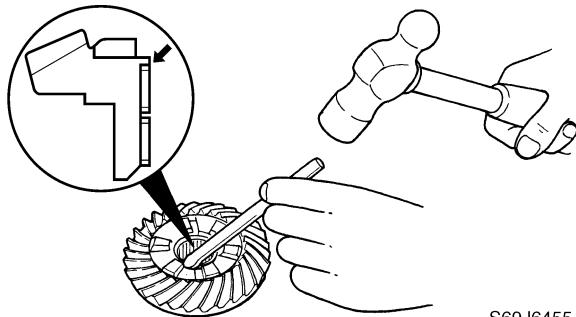
No.	Part name	Q'ty	Remarks
1	Drive shaft	1	
2	Cover	1	
3	Oil seal	2	<b>Not reusable</b>
4	Bolt	4	M8 × 25 mm
5	Drive shaft housing	1	
6	Needle bearing	1	
7	O-ring	1	<b>Not reusable</b> 3 × 60.5 mm
8	Pinion shim	—	As required
9	Thrust bearing	1	
10	Lower case	1	
11	Needle bearing case	1	
12	Needle bearing	24	
13	Pinion	1	
14	Washer	1	
15	Nut	1	
16	Reverse gear shim	—	As required
17	Retainer	1	
18	Needle bearing	1	
19	Thrust bearing	1	
20	Needle bearing	2	<b>Not reusable</b>
21	Reverse gear	1	

**LOWR****Lower unit****Removing the drive shaft**

1. Remove the drive shaft assembly and pinion, and then pull out the reverse gear and thrust bearing.



S69J6175

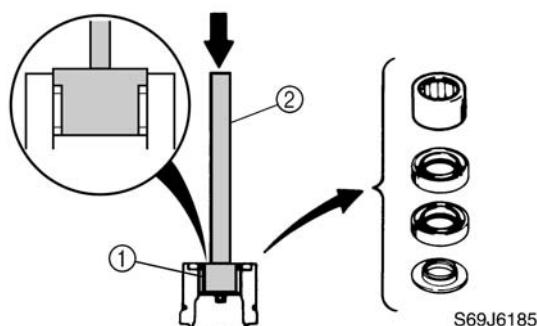


S69J6455

Drive shaft holder ①: YB-06201

**Disassembling the drive shaft housing**

1. Remove the cover, oil seals, and needle bearing.



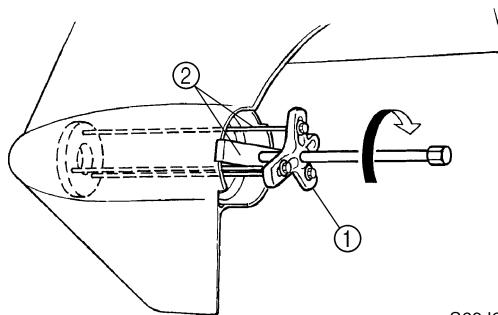
S69J6185

Drive shaft needle bearing remover and installer ①:  
YB-06196

Driver handle ②: YB-06071

**Disassembling the lower case**

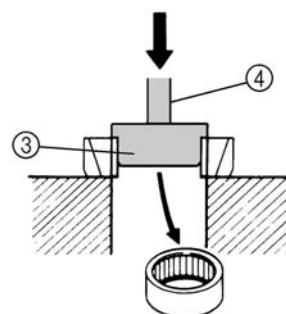
1. Remove the retainer and shim(s).



S69J6460

Universal puller ①: YB-06117  
Puller bolt ②: YB-41707

2. Remove the needle bearing from the retainer.



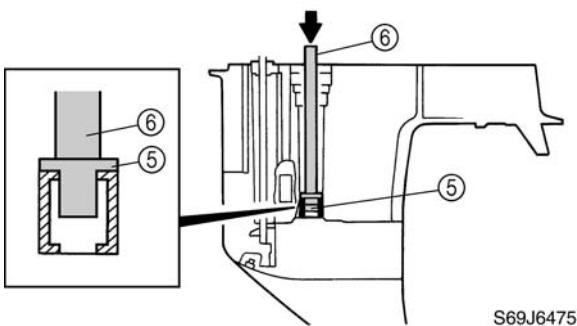
S69J6470

Needle bearing installer ③:  
YB-06434

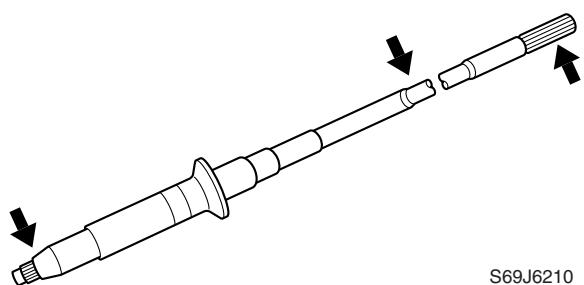
Driver handle ④: YB-06071

3. Remove the needle bearing.

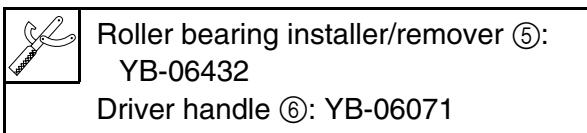
## Drive shaft and lower case (counter rotation model)



S69J6475

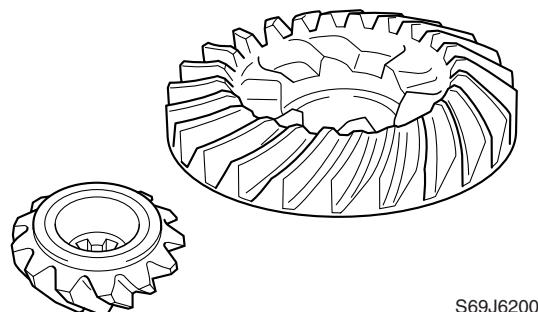


S69J6210



### Checking the pinion and reverse gear

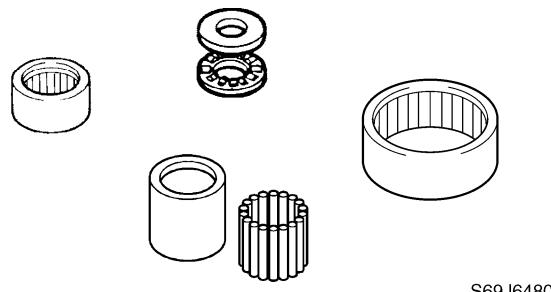
1. Check the teeth of the pinion, and the teeth and dogs of the reverse gear for cracks or wear. Replace if necessary.



S69J6200

### Checking the bearings

1. Check the bearings for pitting or rumbling. Replace if necessary.



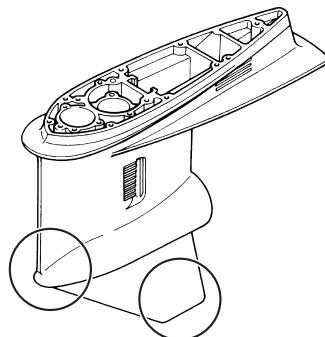
S69J6480

### Checking the drive shaft

1. Check the drive shaft for bends or wear. Replace if necessary.

### Checking the lower case

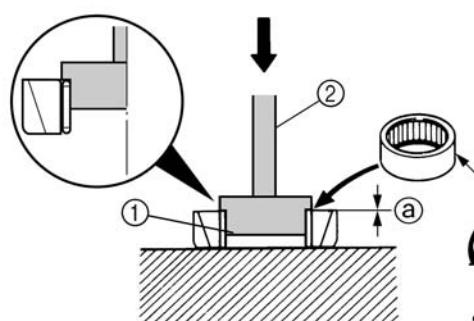
1. Check the skeg and torpedo for cracks or damage. Replace if necessary.



S69J6215

### Assembling the lower case

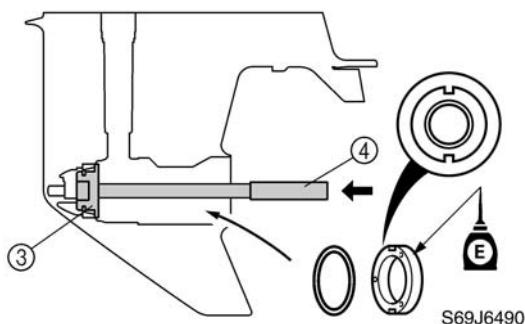
1. Install the needle bearing into the retainer to the specified depth.



S69J6485



2. Install the original shim(s) and retainer into the lower case.

**LOWR****Lower unit****CAUTION:**

**Add or remove shim(s), if necessary, when replacing the forward gear or lower case.**

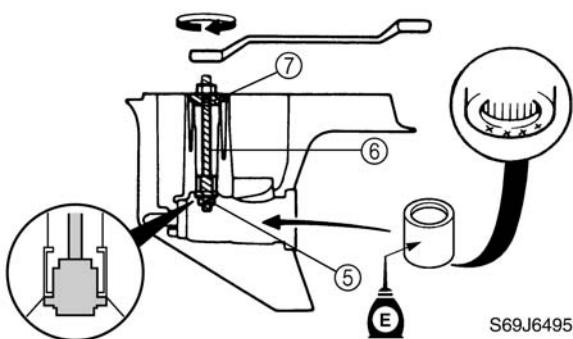


Forward bearing installer ③:

YB-06430

Driver handle ④: YB-06071

- Install the needle bearing outer case into the lower case.

**NOTE:**

Apply engine oil to the needle bearing outer case before installation.



Needle bearing installer ⑤:

YB-06435

Pinion gear bushing installer ⑥:

YB-06029-4

Needle bearing remover and installer  
⑦:

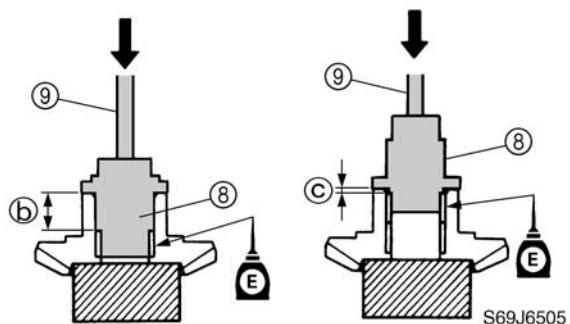
YB-06213

- Install the needle bearing into the needle bearing outer case.

**NOTE:**

Apply engine oil or grease to the needle bearing, and then install it.

- Install the new needle bearings into the reverse gear to the specified depth.



Needle bearing installer ⑧:

YB-06435

Driver handle ⑨: YB-06071



Depth ⑩:

20.75–21.25 mm (0.817–0.836 in)

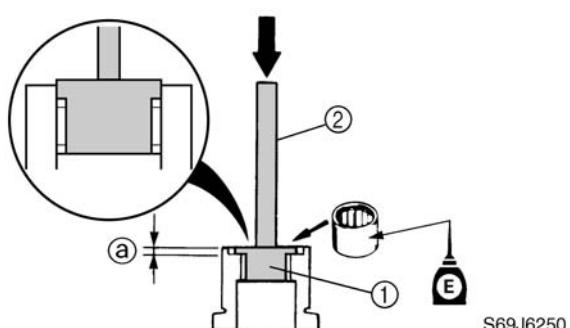
Depth ⑪:

4.25–4.75 mm (0.167–0.187 in)

- Install the thrust bearing and reverse gear into the lower case.

**Assembling the drive shaft housing**

- Install the needle bearing into the drive shaft housing to the specified depth.



Needle bearing installer and remover

①:

YB-06194

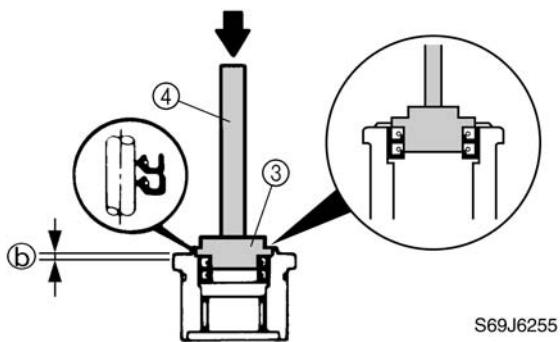
Driver handle ②: YB-06071

## Drive shaft and lower case (counter rotation model)



Depth ①:  
4.25–4.75 mm (0.167–0.187 in)

2. Apply grease to the new oil seals, and then install them into the drive shaft housing to the specified depth.



S69J6255

**NOTE:**

Install an oil seal halfway into the drive shaft housing, then the other oil seal.



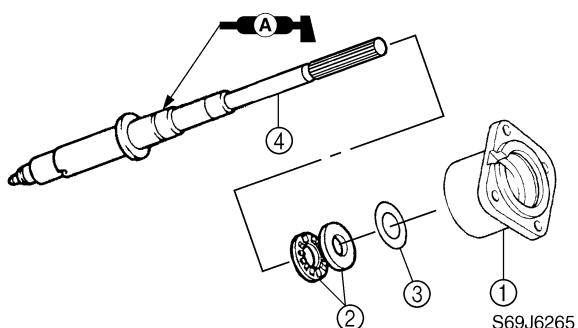
Oil seal installer ③: YB-06195  
Driver handle ④: YB-06071



Depth ②:  
0.25–0.75 mm (0.01–0.03 in)

### Installing the drive shaft

1. Install the forward gear to the lower case.
2. Install the drive shaft housing ①, thrust bearing ②, and original shim(s) ③ to the drive shaft ④.

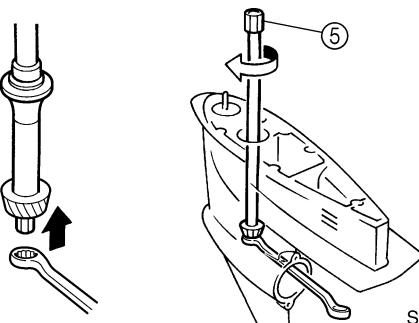


S69J6265

### CAUTION:

Add or remove shim(s), if necessary, when replacing the drive shaft housing or drive shaft.

3. Install the drive shaft, housing, pinion, and pinion nut, and then tighten the nut to the specified torque.



S69J6270

**NOTE:**

Install the drive shaft by lifting it up slightly, then aligning it with the pinion and the spline of the drive shaft.



Drive shaft holder ⑤: YB-06201

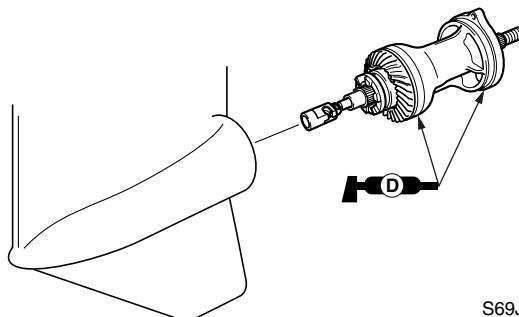


Pinion nut:  
142 N·m (14.2 kgf·m, 103 ft·lb)

4. Tighten the housing bolts.

### Installing the propeller shaft housing

1. Install the propeller shaft housing assembly into the lower case.

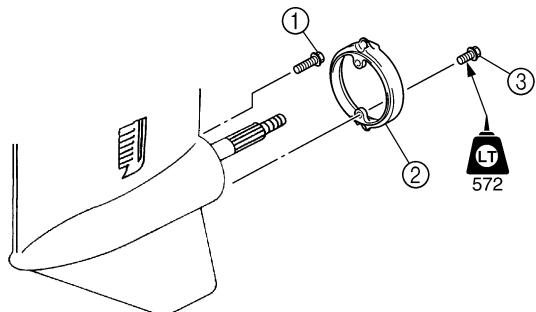


S69J6515

**LOWR****Lower unit****NOTE:**

Apply grease to the new O-rings before installation.

- Install the bolts ①, ring ②, and bolts ③, and then tighten the bolts ① to the specified torque.

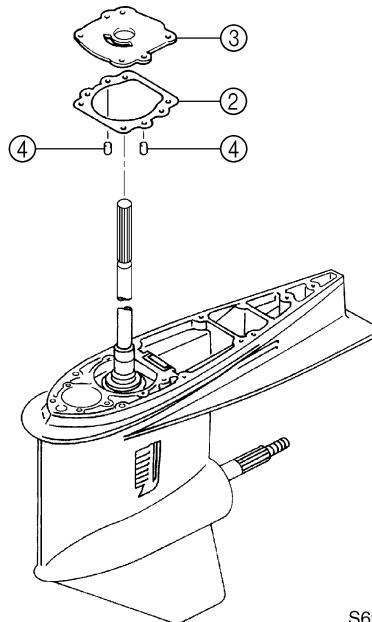


S69J6520



Propeller shaft housing bolt ①:  
30 N·m (3.0 kgf·m, 22 ft·lb)

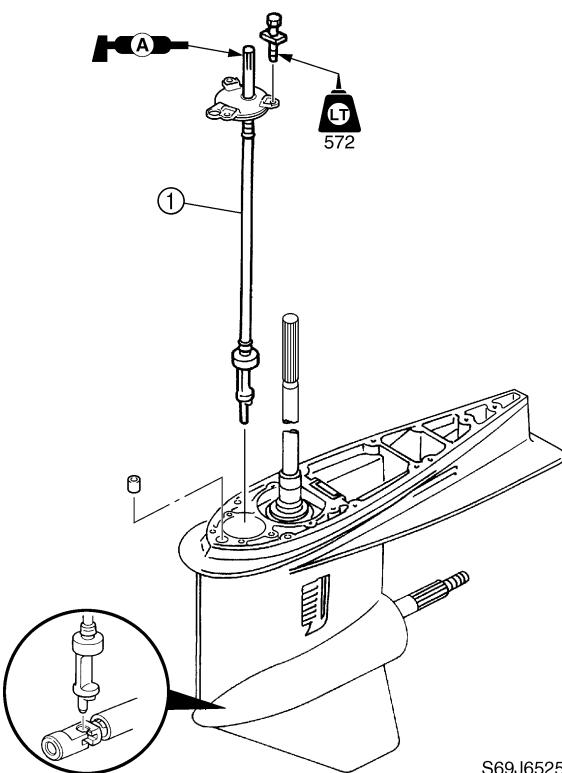
- Install the new gasket ②, outer plate cartridge ③, and dowel pins ④.



S69J6295

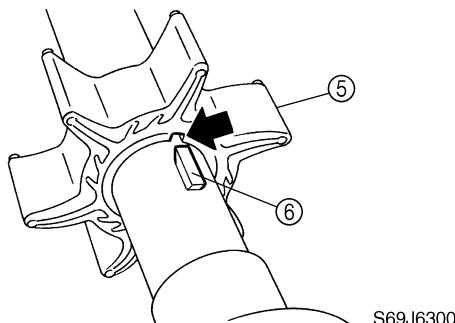
### Installing the water pump and shift rod

- Install the shift rod assembly ①.



S69J6525

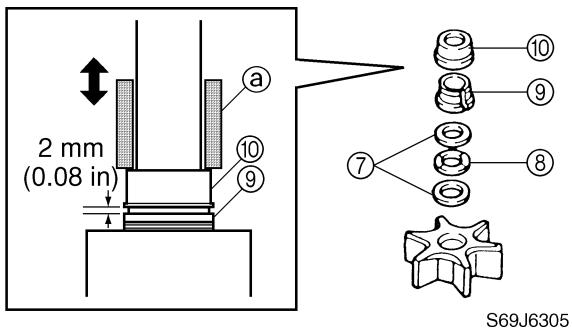
- Install the Woodruff key into the drive shaft.
- Align the groove on the impeller ⑤ with the Woodruff key ⑥, and then install it to the drive shaft.



S69J6300

## Drive shaft and lower case (counter rotation model)

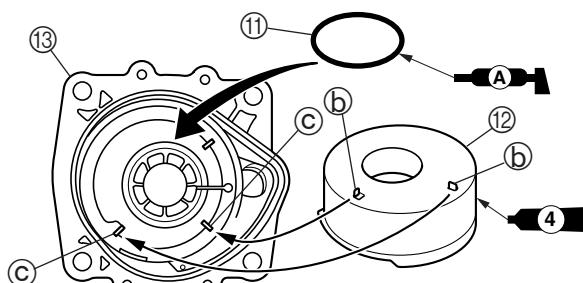
5. Install the washers ⑦, wave washer ⑧, spacer ⑨, and collar ⑩ to the drive shaft.



**NOTE:**

- The collar and spacer should fit together firmly.
- While pulling the drive shaft up, install the collar with an appropriate tool ⑩ that fits over the drive shaft as shown.

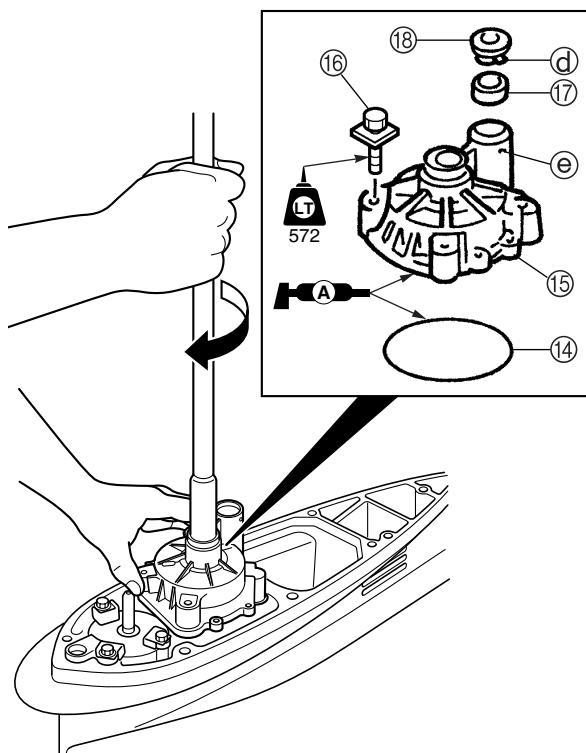
6. Install the O-ring ⑪ and insert cartridge ⑫ into the pump housing ⑬.



**NOTE:**

Align the insert cartridge projections ⑭ with the holes ⑮ in the pump housing.

7. Install the O-ring ⑯ and pump housing assembly ⑰ into the lower case, tighten the bolts ⑱, and then install the seal ⑲ and cover ⑳.



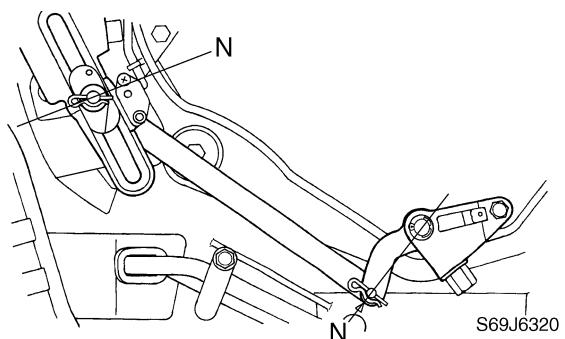
**NOTE:**

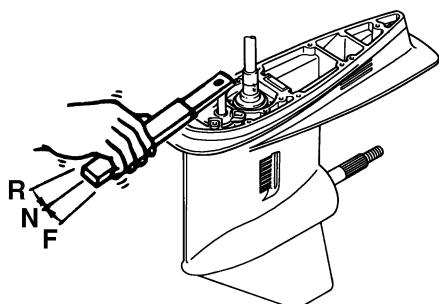
- When installing the pump housing, apply grease to the inside of the housing, and then turn the drive shaft clockwise while pushing down the pump housing.
- Align the cover projection ⑲ with the hole ⑳ in the pump housing.

6

### Installing the lower unit

- Set the gearshift to the neutral position at the lower unit.



**LOWR****Lower unit**

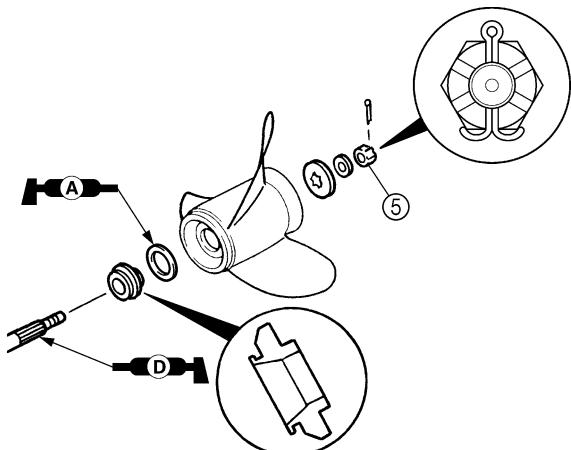
S69J6630



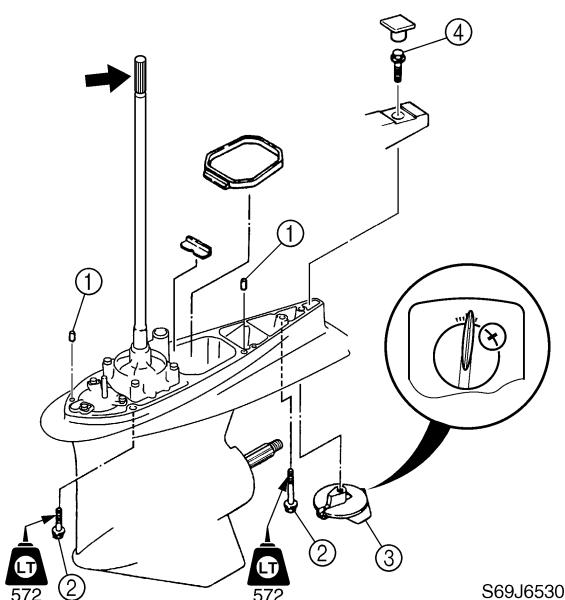
Shift rod push arm: YB-06052

2. Install the two dowel pins ① to the lower unit.
3. Install the lower unit to the upper case, and then tighten the bolts ② to the specified torque.
4. Install the trim tab ③ to its original position, and then tighten the bolt ④ to the specified torque.

5. Install the propeller and propeller nut, and then tighten the nut finger tight. Place a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning, and then tighten the nut to the specified torque.



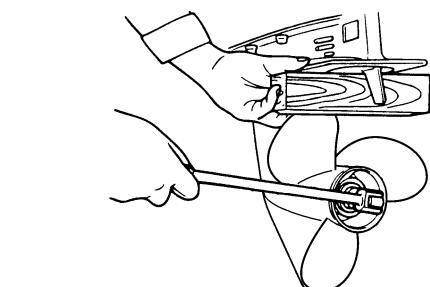
S69J6535



S69J6530



- Lower case bolts ②:  
47 N·m (4.7 kgf·m, 34 ft·lb)  
Trim tab bolt ④:  
43 N·m (4.3 kgf·m, 31 ft·lb)



S69J6540

### **WARNING**

**Do not hold the propeller with your hands when loosening or tightening it. Be sure to disconnect the battery cables from the batteries and the engine stop lanyard switch. Put a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning.**

### **NOTE:** \_\_\_\_\_

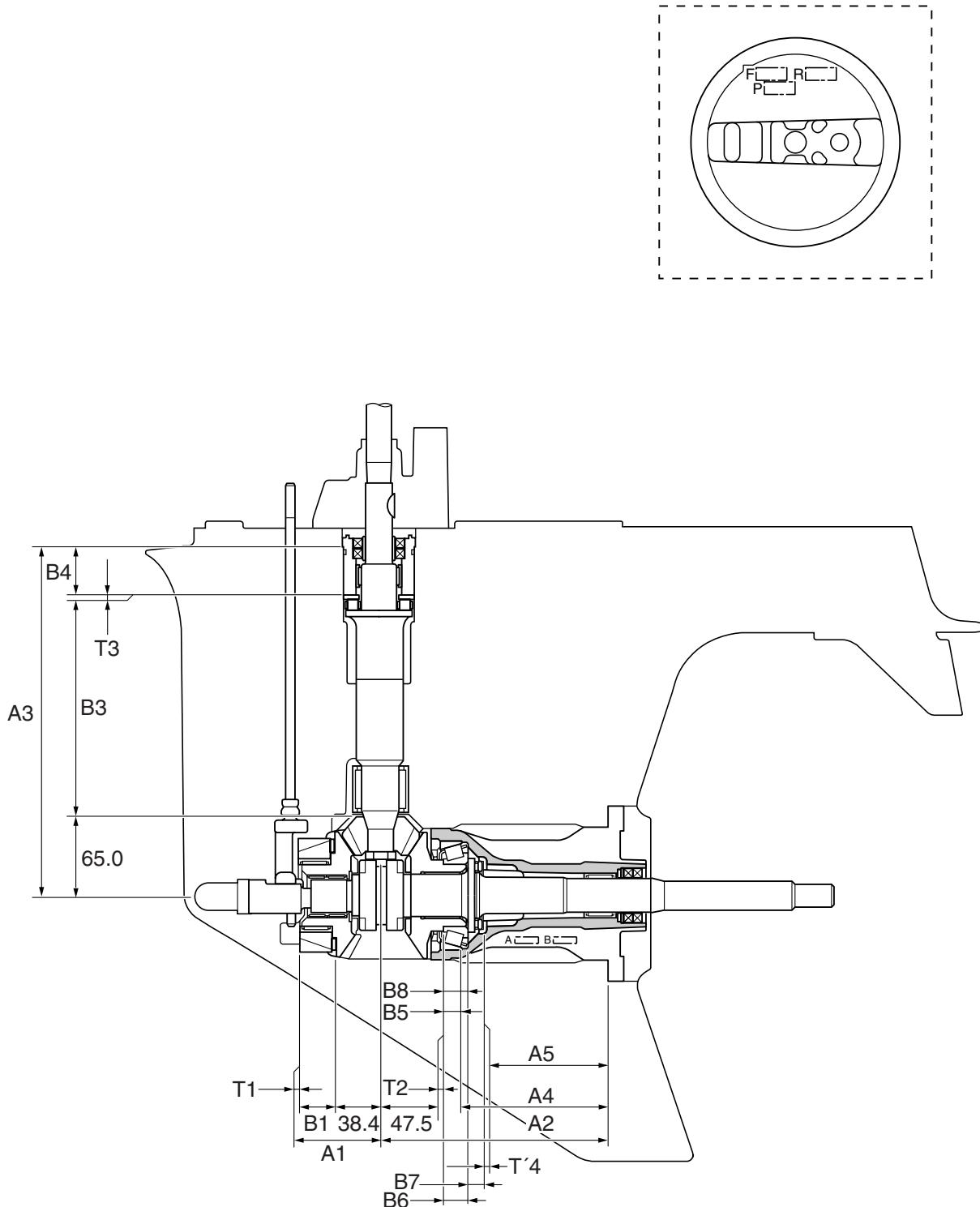
If the grooves in the propeller nut ⑤ do not align with the cotter pin hole, tighten the nut until they are aligned.



- Propeller nut ⑤:  
55 N·m (5.5 kgf·m, 40 ft·lb)

## **Drive shaft and lower case (counter rotation model) / Shimming (counter rotation model)**

### **Shimming (counter rotation model)**



S69J6670

**LOWR****Lower unit**

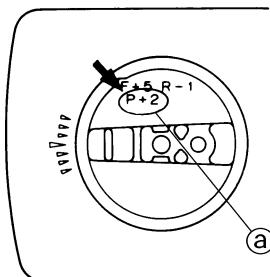
## Shimming

**NOTE:**

- Shimming is not required when assembling the original lower case and inner parts.
- Shimming is required when assembling the original inner parts and a new lower case.
- Shimming is required when replacing the inner part(s).

## Selecting the pinion shims

1. Calculate the specified value ( $M_0$ ) as shown in the examples below.



S69J6555

**NOTE:**

“P” is the deviation of the lower case dimension from standard. The “P” mark ④ is stamped on the trim tab mounting surface of the lower case in 0.01 mm units. If the “P” mark is unreadable, assume that “P” is zero and check the backlash when the unit is assembled.

**Calculation formula:**

$$\text{Specified value } (M_0) = 1.00 + P/100 \text{ mm}$$

**Example:**

If “P” is (+5), then

$$M_0 = 1.00 + (+5)/100 \text{ mm} = 1.00 + 0.05 \text{ mm} \\ = 1.05 \text{ mm}$$

If “P” is (-3), then

$$M_0 = 1.00 + (-3)/100 \text{ mm} = 1.00 - 0.03 \text{ mm} \\ = 0.97 \text{ mm}$$

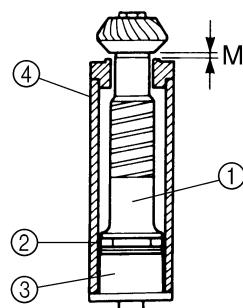
2. Install the drive shaft ①, thrust bearing ②, and drive shaft housing ③ to the shimming tool.

3. Install the pinion and pinion nut, and then tighten the nut to the specified torque.


**Pinion shimming gauge III ④:**  
YB-06441

**Pinion nut:**  
142 N·m (14.2 kgf·m, 103 ft·lb)

4. Measure the clearance (M) between the shimming tool and the pinion as shown.

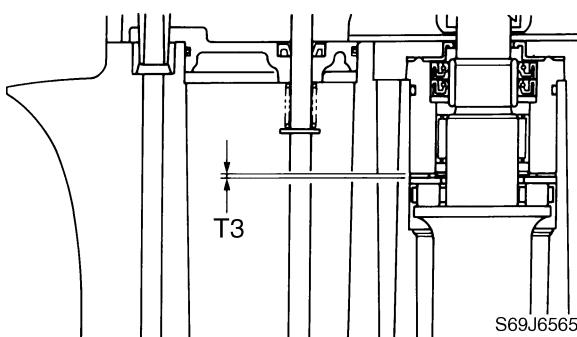


S69J6560

**NOTE:**

Measure the pinion at three points to find the clearance average.

5. Select the pinion shim(s) (T3).



S69J6565

**NOTE:**

The sum of T3 and M should not be more than  $M_0$ .

**Calculation formula:**

$$\text{Pinion shim thickness } (T3) = M_0 - M$$

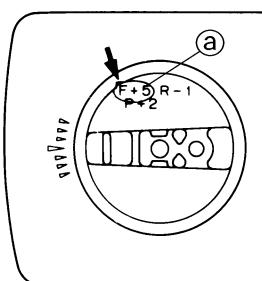
**Available shim thicknesses:**

0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and  
0.50 mm

## Shimming (counter rotation model)

### Selecting the reverse gear shims

- Calculate the specified value ( $M_0$ ) as shown in the examples below.



S69J6570

#### NOTE:

"F" is the deviation of the lower case dimension from standard. The "F" mark **a** is stamped on the trim tab mounting surface of the lower case in 0.01 mm units. If the "F" mark is unreadable, assume that "F" is zero and check the backlash when the unit is assembled.

#### Calculation formula:

$$\text{Specified value } (M_0) = 30.60 + F/100 \text{ mm}$$

#### Example:

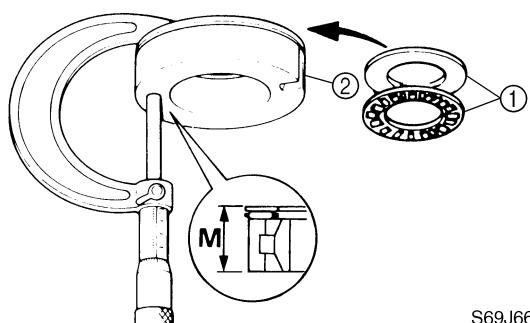
If "F" is (+5), then

$$M_0 = 30.60 + (+5)/100 \text{ mm} = 30.60 + 0.05 \text{ mm} \\ = 30.65 \text{ mm}$$

If "F" is (-3), then

$$M_0 = 30.60 + (-3)/100 \text{ mm} = 30.60 - 0.03 \text{ mm} \\ = 30.57 \text{ mm}$$

- Set the thrust bearing **①** to the bearing retainer **②** as shown.
- Turn the thrust bearing two or three times to seat the bearing retainer, and then measure the bearing height ( $M$ ).

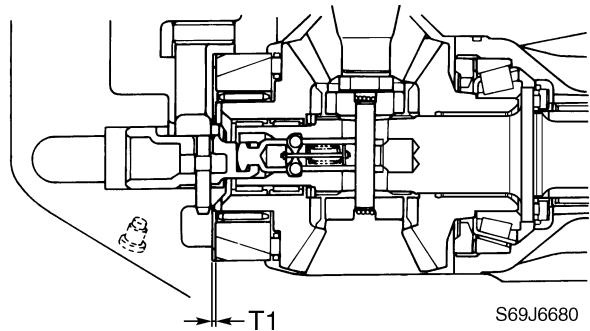


S69J6675

#### NOTE:

Measure the bearing retainer at three points to find the clearance average.

- Select the reverse gear shim(s) ( $T_1$ ).



S69J6680

#### NOTE:

The sum of  $T_1$  and  $M$  should not be more than  $M_0$ .

#### Calculation formula:

$$\text{Reverse gear shim thickness } (T_1) = M_0 - M$$

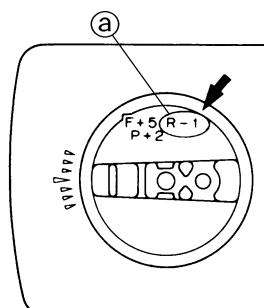
#### Available shim thicknesses:

0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

**6**

### Selecting the forward gear shims

- Calculate the specified value ( $M_0$ ) as shown in the examples below.



S69J6585

**LOWR****Lower unit****NOTE:**

"R" is the deviation of the lower case dimension from standard. The "R" mark ⑨ is stamped on the trim tab mounting surface of the lower case in 0.01 mm units. If the "R" mark is unreadable, assume that "R" is zero and check the backlash when the unit is assembled.

Calculation formula:

$$\text{Specified value (M0)} = 2.50 + R/100 \text{ mm}$$

Example:

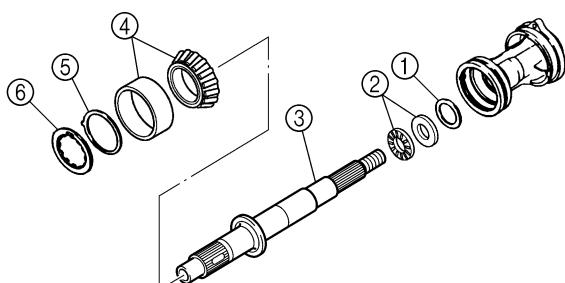
If "R" is (+5), then

$$\begin{aligned} M0 &= 2.50 + (+5)/100 \text{ mm} = 2.50 + 0.05 \text{ mm} \\ &= 2.55 \text{ mm} \end{aligned}$$

If "R" is (-3), then

$$\begin{aligned} M0 &= 2.50 + (-3)/100 \text{ mm} = 2.50 - 0.03 \text{ mm} \\ &= 2.47 \text{ mm} \end{aligned}$$

- Install the shim(s) ①, thrust bearing ②, propeller shaft ③, taper roller bearing ④, and claw washer ⑤, and then tighten the ring nut ⑥ to the specified torque.



S69J6695



Ring nut wrench: YB-06578



Ring nut ⑥:

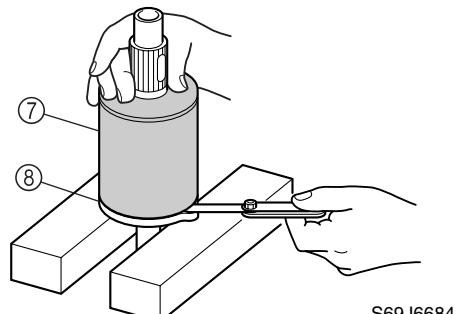
108 N·m (10.8 kgf·m, 78 ft·lb)

- Set the shimming tool on the taper roller bearing inner race.

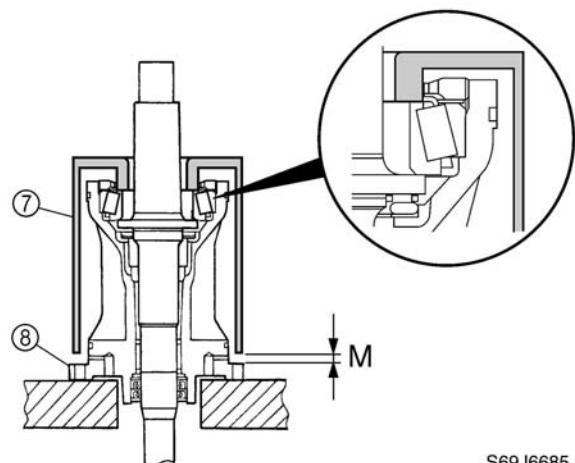


Shimming gauge ⑦: YB-06440-A

- Measure the clearance (M) between the shimming tool and the propeller shaft housing ⑧ as shown.



S69J6684

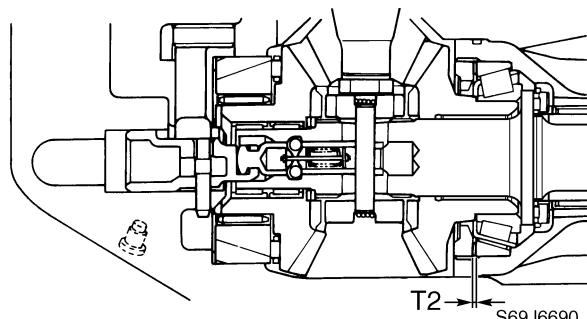


S69J6685

**NOTE:**

Measure the clearance at four points to find the clearance average.

- Select the forward gear shim(s) (T2).



S69J6690

**NOTE:**

The sum of T2 and M should not be more than M0.

## Shimming (counter rotation model) / Backlash (counter rotation model)

Calculation formula:

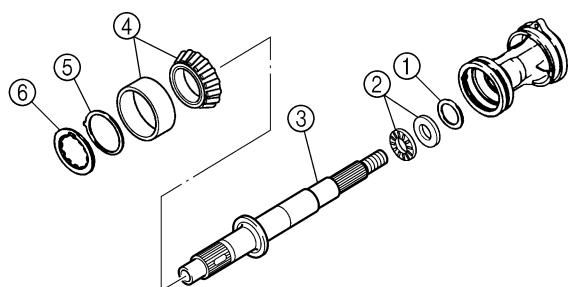
$$\text{Forward gear shim thickness (T2)} = M_0 - M$$

Available shim thicknesses:

0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and  
0.50 mm

### Selecting the propeller shaft shims

1. Install the shim(s) ①, thrust bearing ②, propeller shaft ③, taper roller bearing ④, and claw washer ⑤, and then tighten the ring nut ⑥ to the specified torque.



S69J6695

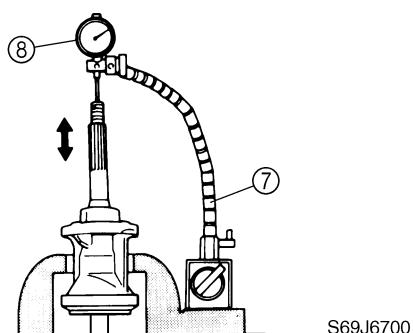


Ring nut wrench: YB-06578



Ring nut ⑥:  
108 N·m (10.8 kgf·m, 78 ft·lb)

2. Measure the propeller shaft free play as shown.



S69J6700

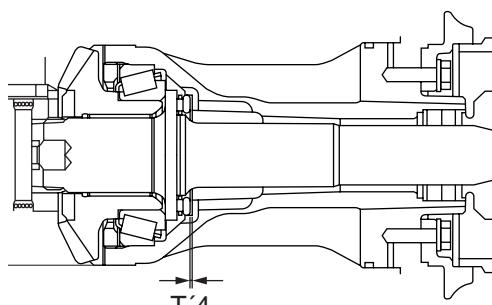


Propeller shaft free play:  
0.25–0.35 mm (0.010–0.014 in)



Magnet flexible stand ⑦: YU-34481  
Dial gauge ⑧: YU-03097

3. Select the propeller shaft shim(s) (T'4).



S69J6705

### NOTE:

Add or remove shim(s), if the free play is out of specification.

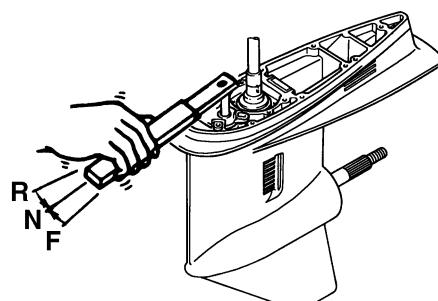
Available shim thicknesses:

0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and  
0.50 mm

### Backlash (counter rotation model) Measuring the forward and reverse gear backlash

1. Remove the water pump assembly.
2. Set the gearshift to the neutral position.

6



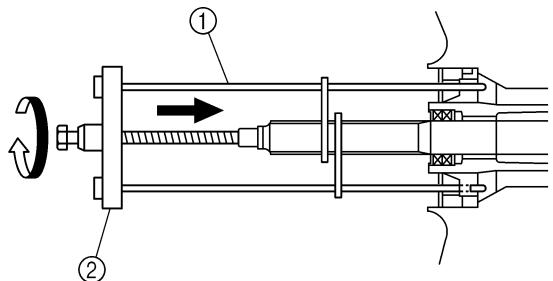
S69J6630



Shift rod push arm: YB-06052

**LOWR****Lower unit**

3. Install the special service tool so that it pushes against the propeller shaft.



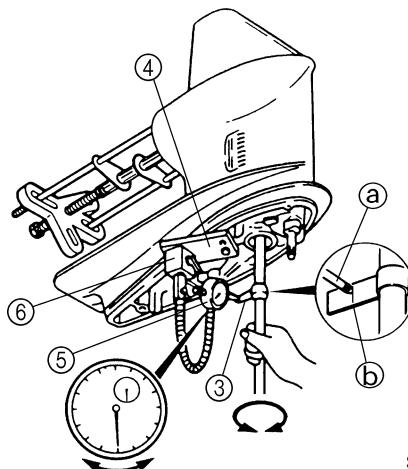
S69J6640

**NOTE:**

Tighten the universal puller or center bolt while turning the drive shaft until the drive shaft can no longer be turned.

Bearing housing puller ①: YB-06207  
Universal puller ②: YB-06117

4. Install the backlash indicator onto the drive shaft (22.4 mm [0.88 in] in diameter), then the dial gauge onto the lower unit.  
5. Set the lower unit upside down.



S69J6650

**NOTE:**

Install the dial gauge so that the plunger ④ contacts the mark ⑥ on the backlash indicator.



Backlash indicator gauge ③:

YB-06265

Magnetic plate ④: YB-07003

Dial gauge ⑤: YU-03097

Magnet flexible stand ⑥: YU-34481

6. Slowly turn the drive shaft clockwise and counterclockwise and measure the backlash when the drive shaft stops in each direction.



Forward gear backlash:

0.35–0.70 mm (0.014–0.028 in)

7. Add or remove shim(s) if out of specification.

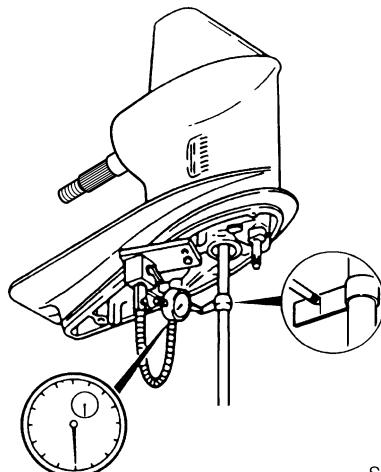
Forward gear backlash	Shim thickness
Less than 0.35 mm (0.014 in)	To be decreased by $(0.53 - M) \times 0.71$
More than 0.70 mm (0.028 in)	To be increased by $(M - 0.53) \times 0.71$

M: Measurement

Available shim thicknesses:

0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

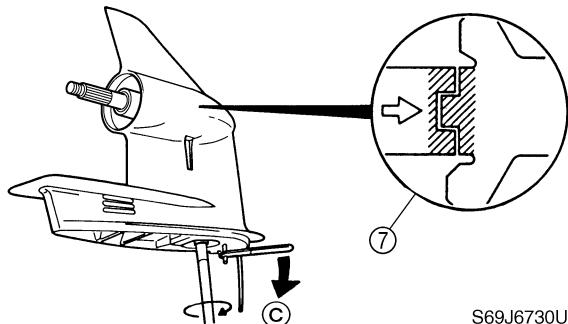
8. Remove the special service tools from the propeller shaft.



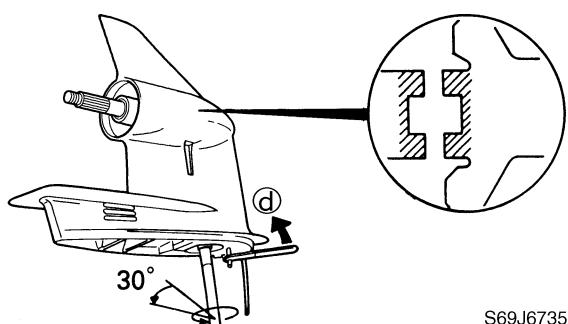
S69J6725

## Backlash (counter rotation model)

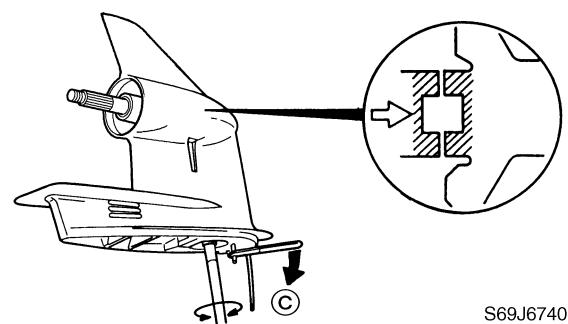
9. Turn the shift rod into the reverse position **(C)** with the shift rod push arm.
10. Turn the drive shaft clockwise until the dog clutch **(7)** is fully engaged.



11. Turn the shift rod to the neutral position **(d)** with the shift rod push arm.
12. Turn the drive shaft counterclockwise approximately  $30^\circ$ .



13. Turn the shift rod to the reverse position **(C)** with the shift rod push arm.
14. Slowly turn the drive shaft clockwise and counterclockwise and measure the backlash when the drive shaft stops in each direction.



### **NOTE:**

When measuring the reverse gear backlash, turn the shift rod push arm towards the reverse position **(C)** with force.



Reverse gear backlash:  
0.70–1.03 mm (0.028–0.041 in)

15. Add or remove shim(s) if out of specification.

Reverse gear backlash	Shim thickness
Less than 0.70 mm (0.028 in)	To be decreased by $(0.87 - M) \times 0.71$
More than 1.03 mm (0.041 in)	To be increased by $(M - 0.87) \times 0.71$

M: Measurement

### Available shim thicknesses:

0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and  
0.50 mm

16. Remove the special service tools, and then install the water pump assembly.



## Bracket unit

<b>Special service tools .....</b>	<b>7-1</b>
<b>Bottom cowling .....</b>	<b>7-3</b>
<b>Upper case, steering arm, swivel bracket and clamp brackets .....</b>	<b>7-7</b>
Draining the engine oil.....	7-13
Disassembling the oil pan.....	7-13
Checking the oil strainer.....	7-13
Assembling the oil pan .....	7-13
Removing the steering arm .....	7-15
Installing the steering arm .....	7-16
Installing the upper case.....	7-17
Removing the power trim and tilt unit .....	7-17
Removing the clamp brackets .....	7-18
Installing the clamp brackets .....	7-18
Installing the power trim and tilt unit .....	7-18
Adjusting the trim sensor.....	7-19
<b>Power trim and tilt unit .....</b>	<b>7-21</b>
Disassembling the power trim and tilt motor.....	7-27
Checking the power trim and tilt motor .....	7-27
Assembling the power trim and tilt motor .....	7-28
Checking the hydraulic pressure .....	7-29
Disassembling the gear pump .....	7-31
Disassembling the tilt cylinder and trim cylinders .....	7-32
Checking the reservoir.....	7-34
Checking the tilt cylinder and trim cylinder .....	7-34
Checking the valves .....	7-34
Checking the filters .....	7-35
Checking the gear pump .....	7-35
Checking the gear pump housing.....	7-35
Assembling the gear pump .....	7-35
Assembling the tilt ram .....	7-36
Assembling the trim rams .....	7-37
Installing the tilt cylinder .....	7-38
Installing the trim rams .....	7-38
Installing the power trim and tilt motor.....	7-39
Installing the reservoir .....	7-40
Installing the tilt ram.....	7-40
<b>Bleeding the power trim and tilt unit.....</b>	<b>7-41</b>
Not installed.....	7-41
Built-in.....	7-42

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<b>Power trim and tilt electrical system.....</b>	<b>7-43</b>
Checking the fuse.....	7-44
Checking the power trim and tilt relay .....	7-44
Checking the power trim and tilt switch .....	7-45
Checking the trim sensor.....	7-45

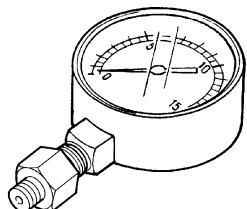
**BRKT**



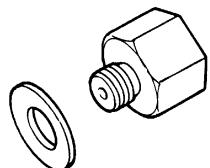
**Bracket unit**

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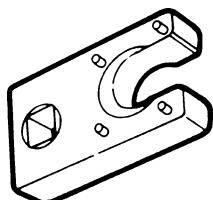
## **Special service tools**



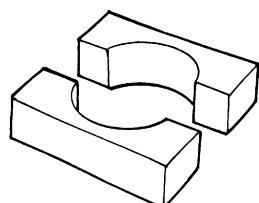
**PTT oil pressure gauge assembly**  
**YB-06580**



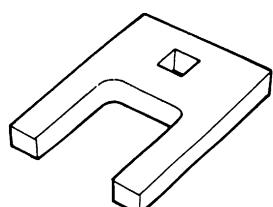
**PTT oil pressure gauge adapter**  
**YB-06581**



**Trim and tilt cylinder wrench**  
**YB-06175-2B**



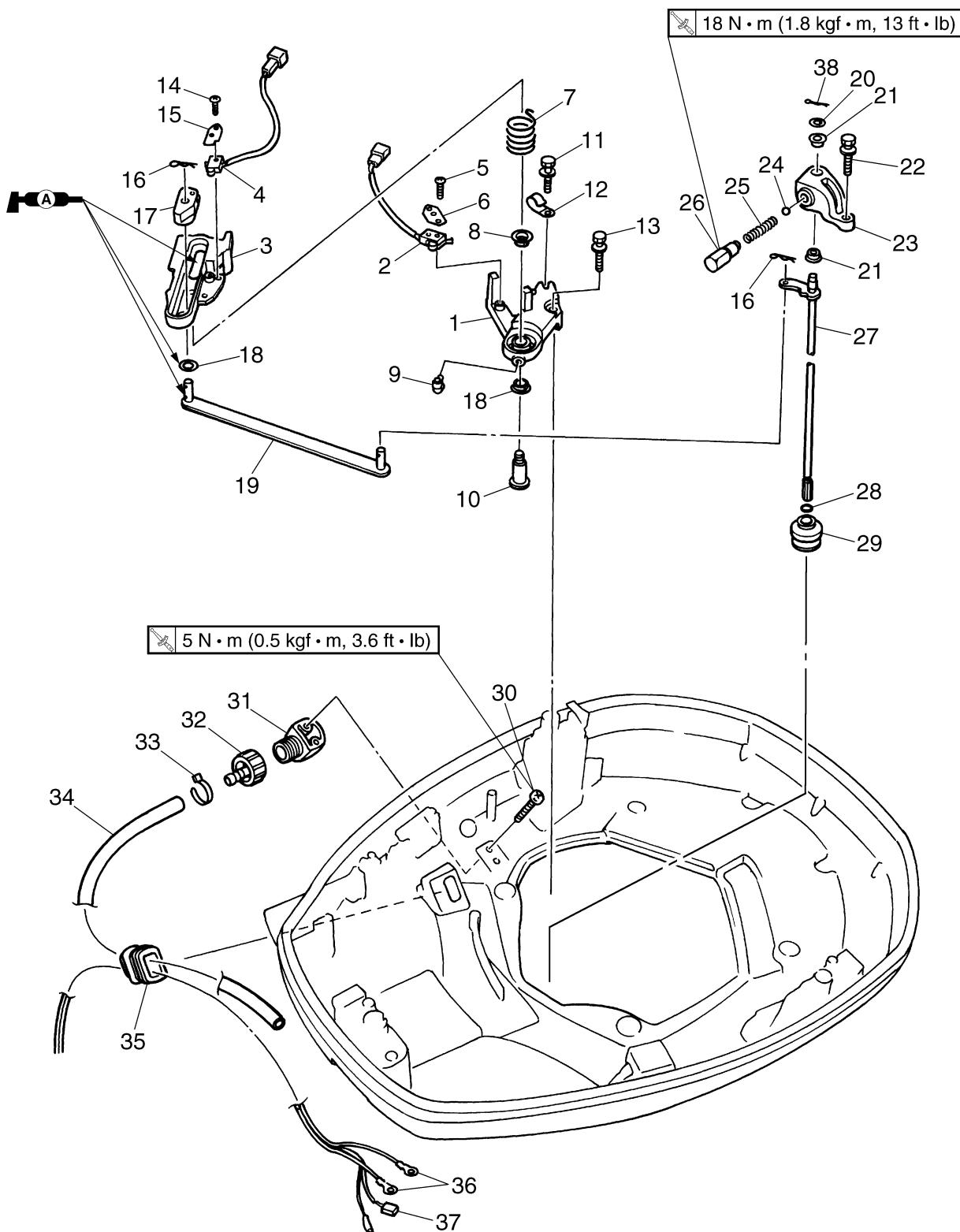
**PTT piston vice attachment**  
**YB-06572**



**Tilt rod wrench**  
**YB-06569**

**— MEMO —**

**7**

**BRKT****Bracket unit****Bottom cowling**

S69J7005

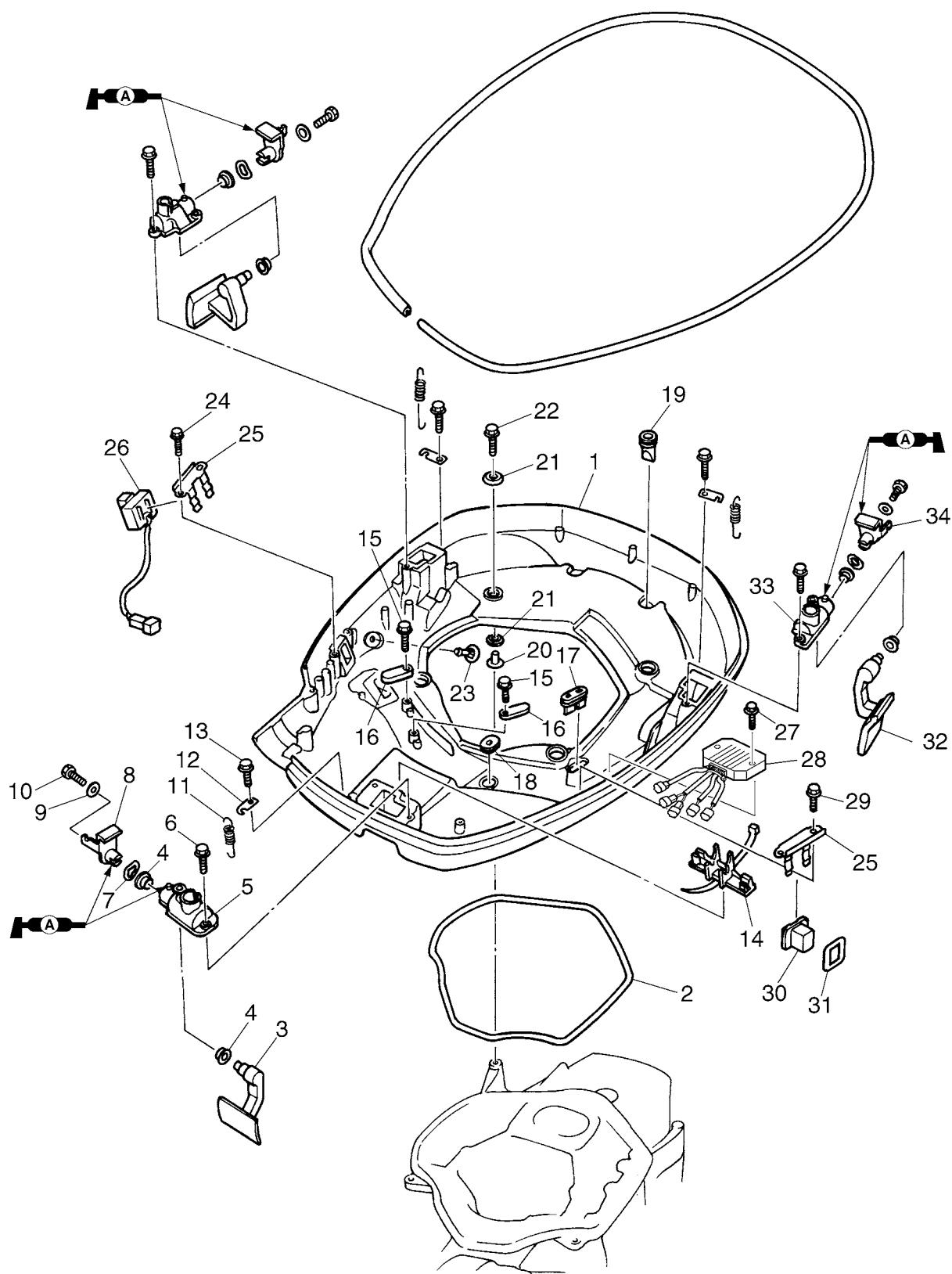
## Bottom cowling

No.	Part name	Q'ty	Remarks
1	Bracket	1	
2	Shift cut switch	1	
3	Bracket	1	
4	Neutral switch	1	
5	Screw	2	M4 × 16 mm
6	Plate	1	
7	Spring	1	
8	Bushing	2	
9	Grease nipple	1	
10	Bolt	1	
11	Bolt	1	M6 × 35 mm
12	Clamp	1	
13	Bolt	1	M6 × 35 mm
14	Screw	2	M4 × 16 mm
15	Plate	1	
16	Clip	2	
17	Bushing	1	
18	Washer	1	
19	Shift lever	1	
20	Washer	1	
21	Bushing	2	
22	Bolt	1	M6 × 30 mm
23	Bracket	1	
24	Ball	1	
25	Spring	1	
26	Bolt	1	
27	Shift rod	1	
28	O-ring	1	<b>Not reusable</b> 1.9 × 12.6 mm
29	Grommet	1	
30	Screw	1	M6 × 20 mm
31	Adapter	1	
32	Hose joint	1	
33	Plastic tie	1	<b>Not reusable</b>
34	Flushing hose	1	11 × 650 mm
35	Grommet	1	
36	PTT motor lead	1	
37	Trim sensor coupler	1	
38	Cotter pin	1	

BRKT



Bracket unit



S69J7010U

## Bottom cowling

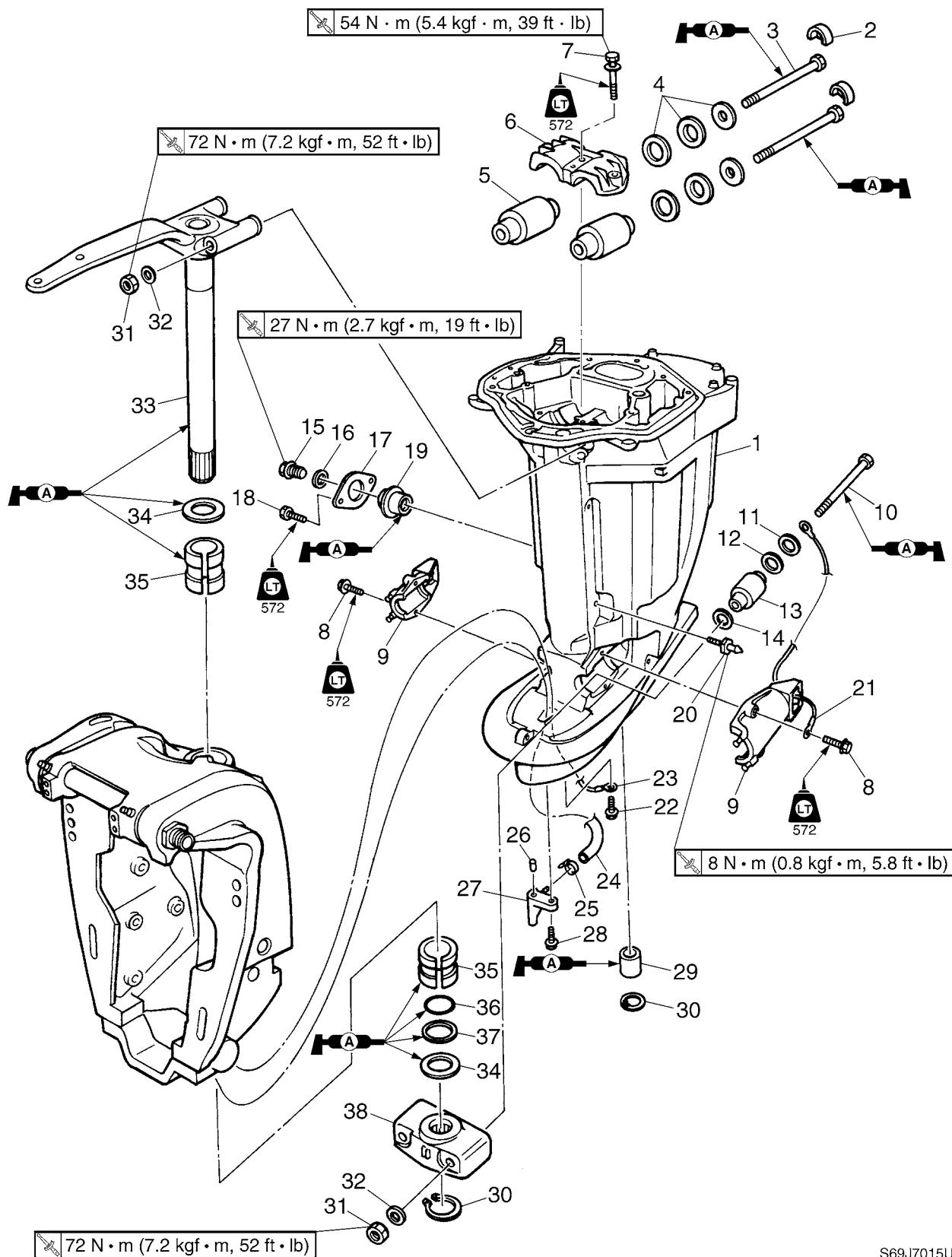
No.	Part name	Q'ty	Remarks
1	Bottom cowling	1	
2	Rubber seal	1	
3	Cowling lock lever	2	
4	Bushing	6	
5	Plate	2	
6	Bolt	6	M6 × 30 mm
7	Wave washer	3	
8	Lever	2	
9	Washer	3	
10	Bolt	3	M6 × 20 mm
11	Spring	3	
12	Hook	3	
13	Bolt	3	M6 × 20 mm
14	Bracket	1	
15	Bolt	2	M6 × 25 mm
16	Plate	2	
17	Grommet	2	
18	Grommet	1	
19	Grommet	2	
20	Collar	4	
21	Grommet	8	
22	Bolt	4	M6 × 30 mm
23	Cooling water pilot hole	1	
24	Bolt	2	M6 × 20 mm
25	Bracket	2	
26	Trailer switch	1	
27	Bolt	2	
28	Fuel pump driver and isolator	1	
29	Bolt	2	M6 × 20 mm
30	Cover	1	
31	Gasket	1	
32	Cowling lock lever	1	
33	Plate	1	
34	Lever	1	

BRKT



Bracket unit

## Upper case, steering arm, swivel bracket and clamp brackets



S69J7015U

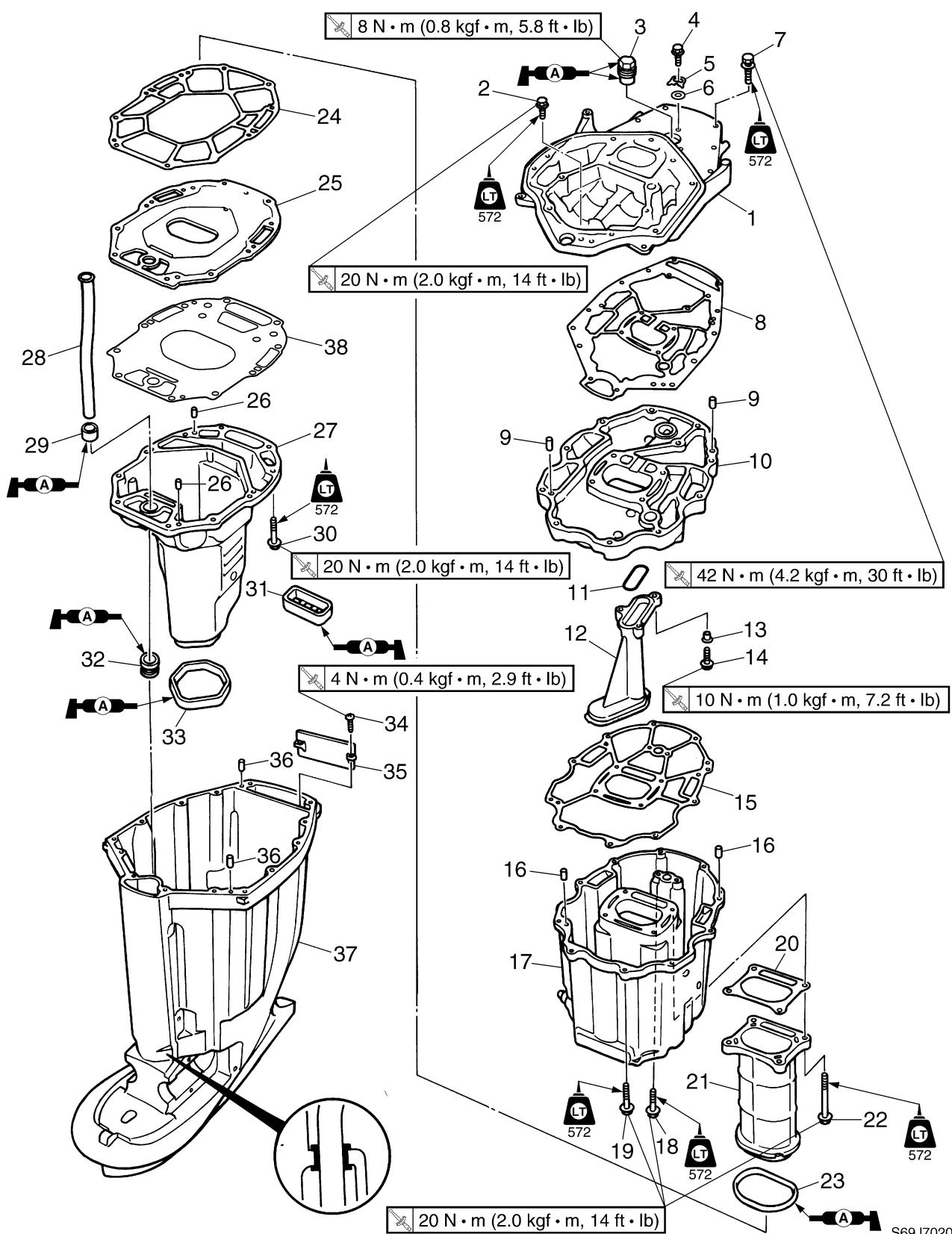
## Upper case, steering arm, swivel bracket and clamp brackets

No.	Part name	Q'ty	Remarks
1	Upper case assembly	1	
2	Damper	2	
3	Bolt	2	M14 × 190 mm
4	Washer	6	
5	Upper mount	2	
6	Bracket	1	
7	Bolt	3	M10 × 40 mm
8	Bolt	4	M10 × 40 mm
9	Mount housing	2	
10	Bolt	2	M14 × 205 mm
11	Washer	2	
12	Rubber washer	2	
13	Lower mount	2	
14	Washer	2	
15	Drain bolt	1	M14 × 12 mm
16	Metal gasket	1	<b>Not reusable</b>
17	Cover	1	
18	Bolt	2	M6 × 14 mm
19	Damper	1	
20	Apron stay	6	
21	Ground lead	1	
22	Bolt	1	M6 × 10 mm
23	Ground lead	1	
24	Hose	1	
25	Plastic tie	1	
26	Dowel pin	1	
27	Adapter	1	
28	Bolt	1	M6 × 25 mm
29	Drive shaft bushing	1	
30	Circlip	2	
31	Nut	4	
32	Washer	4	
33	Steering arm	1	
34	Washer	2	
35	Bushing	2	
36	O-ring	1	<b>Not reusable</b>
37	Bushing	1	
38	Steering yoke	1	

BRKT



## Bracket unit



S69J7020

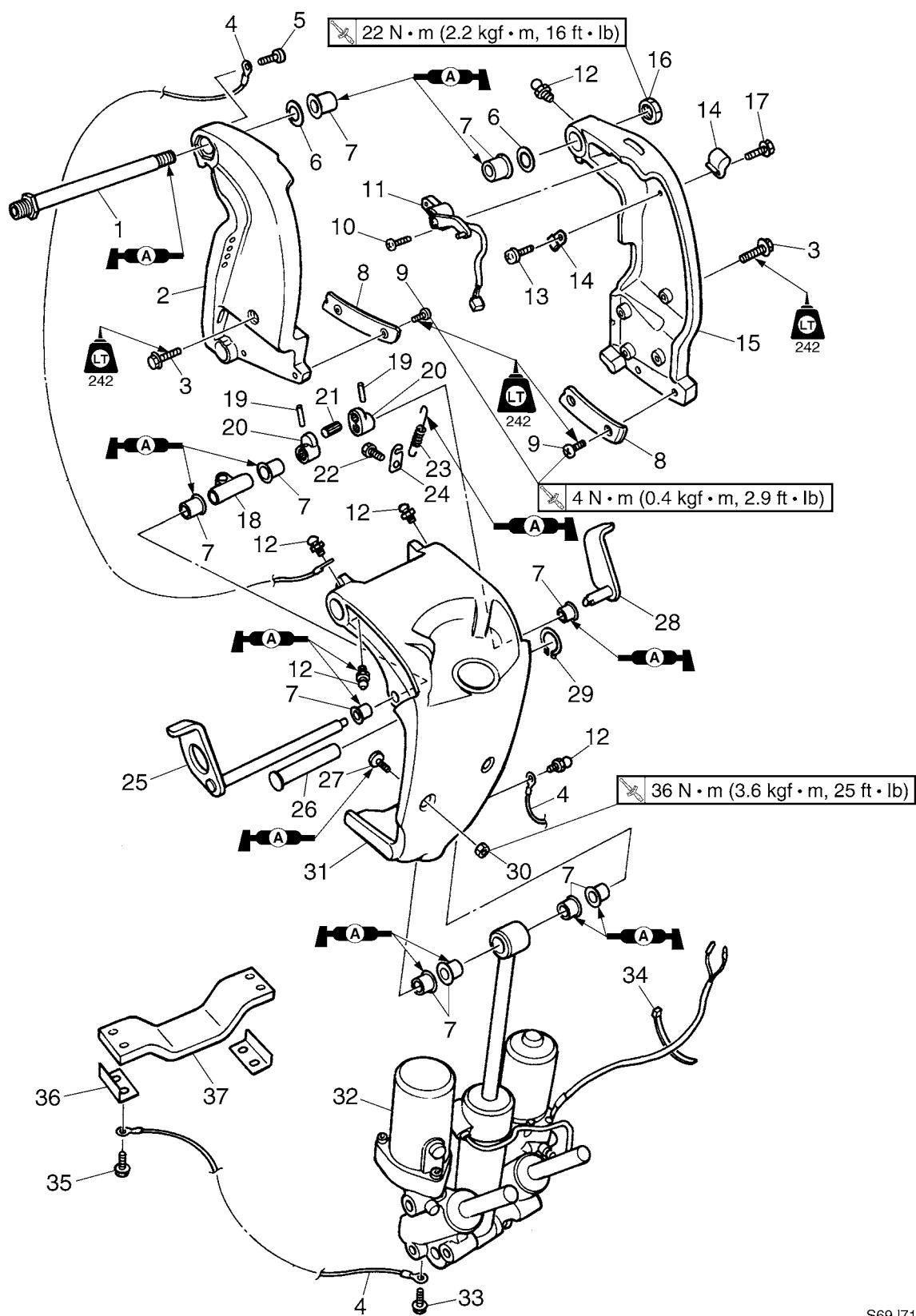
## Upper case, steering arm, swivel bracket and clamp brackets

No.	Part name	Q'ty	Remarks
1	Upper exhaust guide	1	
2	Bolt	2	M8 × 35 mm
3	Pressure control valve	1	
4	Bolt	1	M6 × 20 mm
5	Plate	1	
6	Collar	1	
7	Bolt	7	M10 × 45 mm
8	Gasket	1	<b>Not reusable</b>
9	Dowel pin	2	
10	Lower exhaust guide	1	
11	Gasket	1	<b>Not reusable</b>
12	Oil strainer	1	
13	Collar	3	
14	Bolt	3	M6 × 25 mm
15	Gasket	1	<b>Not reusable</b>
16	Dowel pin	2	
17	Oil pan	1	
18	Bolt	2	M8 × 30 mm
19	Bolt	10	M8 × 60 mm
20	Gasket	1	<b>Not reusable</b>
21	Exhaust manifold	1	
22	Bolt	4	M8 × 90 mm
23	Exhaust seal	1	
24	Gasket	1	<b>Not reusable</b>
25	Plate	1	
26	Dowel pin	2	
27	Muffler	1	
28	Cooling water pipe	1	
29	Rubber seal	1	
30	Bolt	10	M8 × 35 mm
31	Muffler seal	1	
32	Rubber seal	1	
33	Rubber seal	1	
34	Screw	2	M6 × 16 mm
35	Baffle plate	1	
36	Dowel pin	2	
37	Upper case	1	
38	Gasket	1	<b>Not reusable</b>

BRKT



## Bracket unit



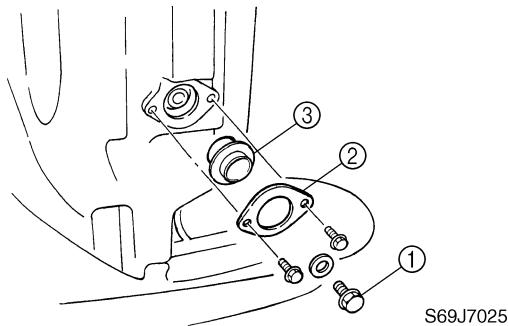
S69J7105U

## Upper case, steering arm, swivel bracket and clamp brackets

No.	Part name	Q'ty	Remarks
1	Through tube	1	
2	Port clamp bracket	1	
3	Bolt	8	M10 × 45 mm
4	Ground lead	3	
5	Screw	1	
6	Washer	2	
7	Bushing	10	
8	Friction plate	2	
9	Screw	4	M6 × 10 mm
10	Screw	2	M6 × 15 mm
11	Trim sensor	1	
12	Grease nipple	6	
13	Screw	1	M6 × 12 mm
14	Clamp	2	
15	Starboard clamp bracket	1	
16	Self-locking nut	1	
17	Bolt	1	M6 × 14 mm
18	Collar	1	
19	Pin	2	
20	Tilt stop lever joint	2	
21	Pin	1	
22	Bolt	1	M6 × 10 mm
23	Spring	1	
24	Spring holder	1	
25	Port tilt stop lever	1	
26	Shaft	1	
27	Trim stopper	2	
28	Starboard tilt stop lever	1	
29	Circlip	1	
30	Nut	2	
31	Swivel bracket	1	
32	Power trim and tilt unit	1	
33	Bolt	1	M6 × 10 mm
34	Plastic tie	4	
35	Bolt	4	M6 × 25 mm
36	Bracket	2	
37	Anode	1	

**BRKT****Bracket unit****Draining the engine oil**

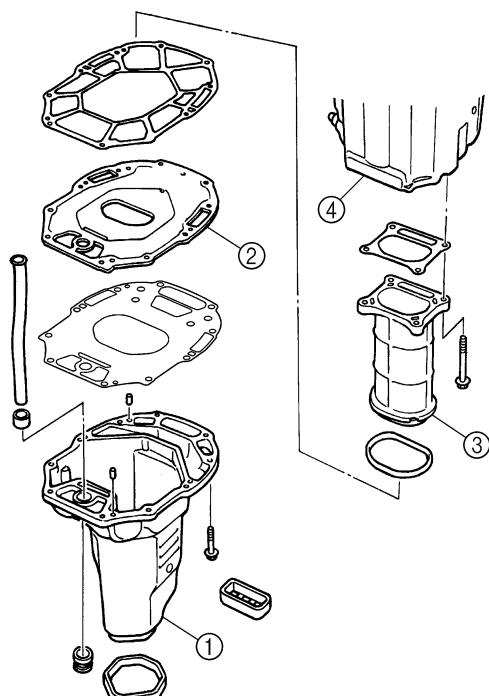
1. Place a drain pan under the drain hole, and then remove the drain bolt ① and let the oil drain completely.
2. Remove the cover ② and damper ③.



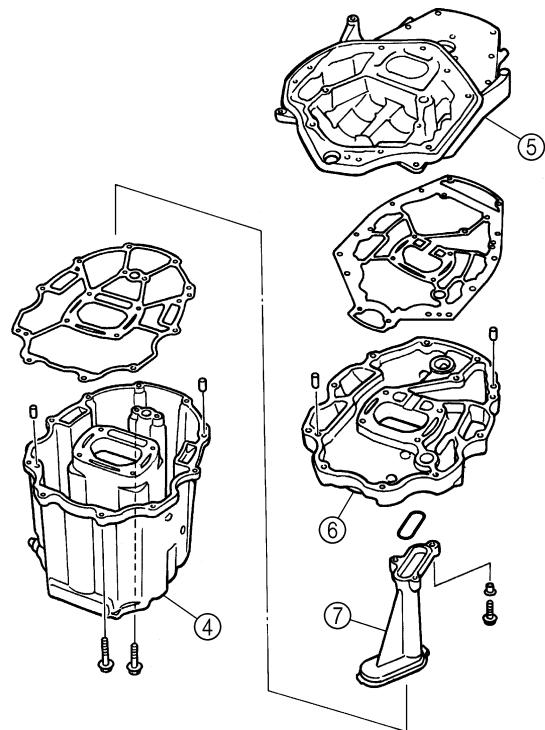
3. Remove the upper and lower mounting nut, and then remove the upper case.
4. Remove the muffler assembly from the upper case.

**Disassembling the oil pan**

1. Remove the muffler ①, plate ②, and exhaust manifold ③ from the oil pan ④.



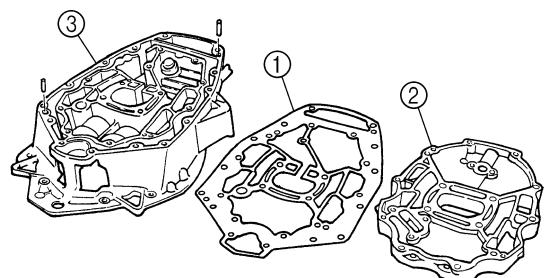
2. Remove the oil pan ④ from the upper exhaust guide ⑤ and lower exhaust guide ⑥.
3. Remove the oil strainer ⑦ from the lower exhaust guide ⑥.

**Checking the oil strainer**

1. Check the oil strainer for dirt and residue. Clean if necessary.

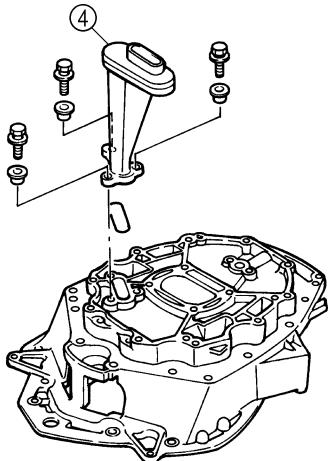
**Assembling the oil pan**

1. Install the gasket ① and lower exhaust guide ② onto the upper exhaust guide ③.



## Upper case, steering arm, swivel bracket and clamp brackets

2. Install the oil strainer ④ and bolts, and then tighten the bolts to the specified torque.

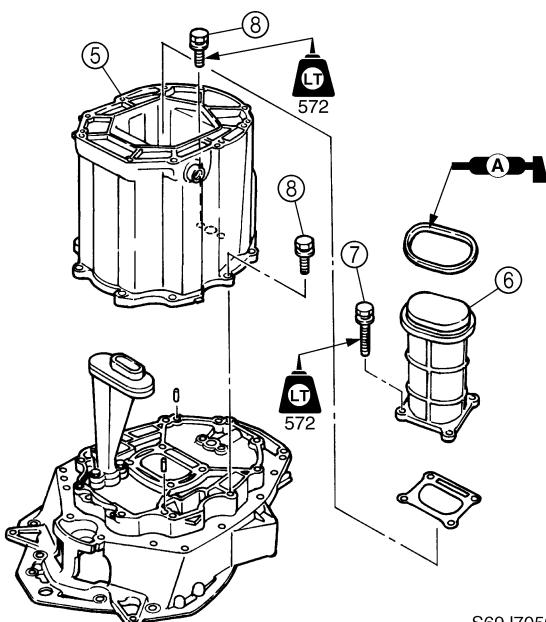


S69J7045



Exhaust manifold bolt ⑦:  
20 N·m (2.0 kgf·m, 14 ft·lb)  
Oil pan bolt ⑧:  
20 N·m (2.0 kgf·m, 14 ft·lb)

3. Install the oil pan ⑤, and then tighten the bolts finger tight.  
4. Install the exhaust manifold ⑥ and bolts, and then tighten the bolts finger tight.

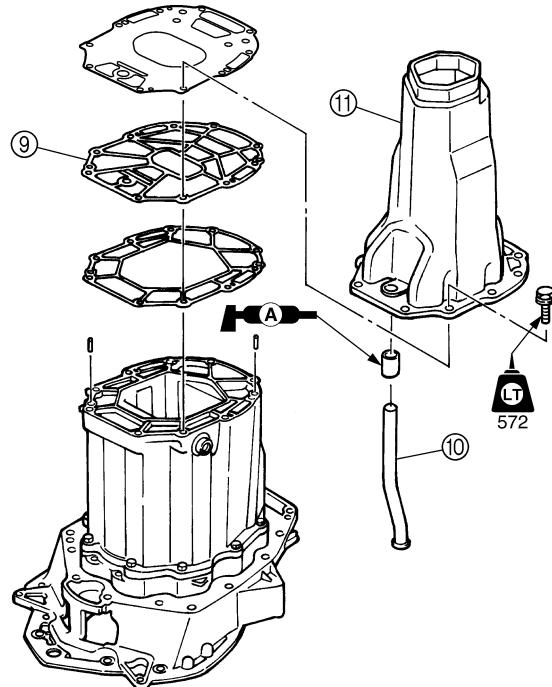


S69J7050

5. Tighten the exhaust manifold bolts ⑦, then the oil pan bolts ⑧, and then tighten them to the specified torques.

6. Install the plate ⑨.

7. Install the cooling water pipe ⑩ into the muffler ⑪.  
8. Install the muffler ⑪ and bolts into the oil pan, and then tighten the bolts to the specified torque.

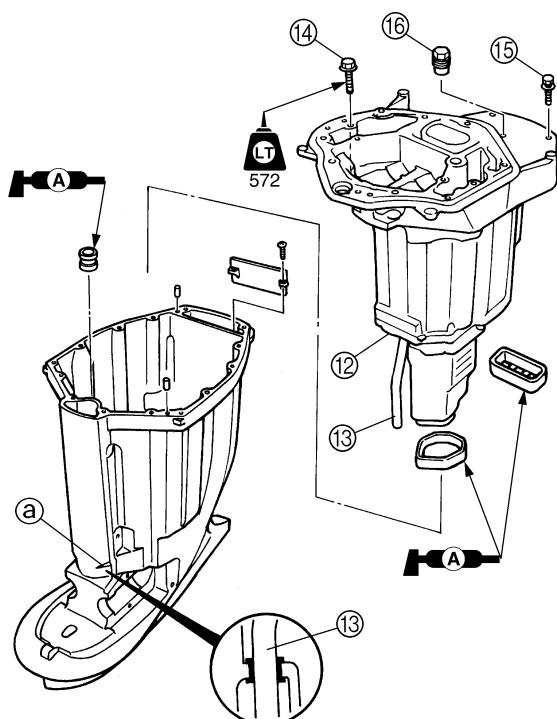


S69J7055

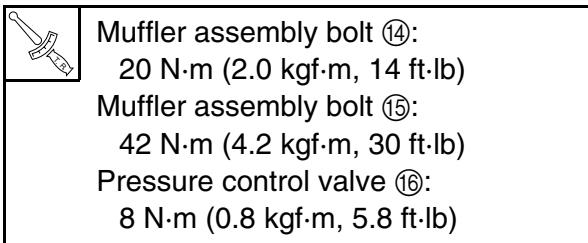


Muffler bolt:  
20 N·m (2.0 kgf·m, 14 ft·lb)

9. Install the muffler assembly ⑫ by inserting the tip of the cooling water pipe ⑬ into the joint hole ⑭ of the upper case.  
10. Install muffler assembly bolts ⑭ and ⑮, and pressure control valve ⑯, and then tighten them to the specified torques.

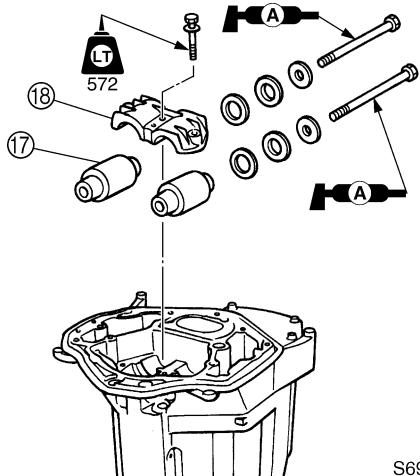
**BRKT****Bracket unit**

S69J7060



11. Install the upper mounts ⑯ and bolts into the upper case.

12. Install the bracket ⑰, and then tighten the bolts to the specified torque.

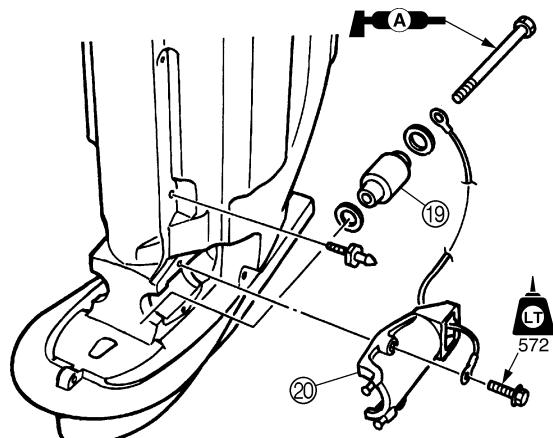


S69J7075U



Bracket bolt:  
54 N·m (5.4 kgf·m, 39 ft·lb)

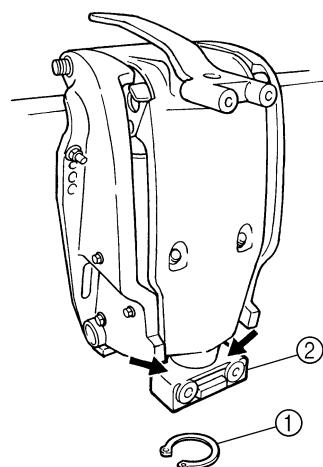
13. Install the lower mounts ⑯ and mount housings ⑰.



S69J7070

### Removing the steering arm

1. Remove the circlip ①.
2. Remove the steering yoke ② by striking it with a plastic hammer.



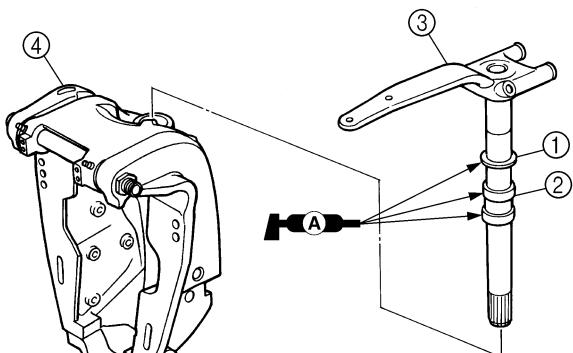
S69J7075

3. Remove the steering arm from the swivel bracket by pulling the arm off the bracket.

## Upper case, steering arm, swivel bracket and clamp brackets

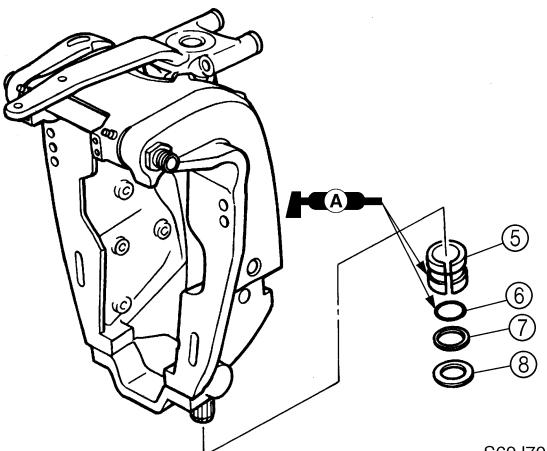
### Installing the steering arm

1. Install the washer ① and bushing ② onto the steering arm ③.
2. Place the swivel bracket ④ in an upright position, and then install the steering arm onto the swivel bracket.



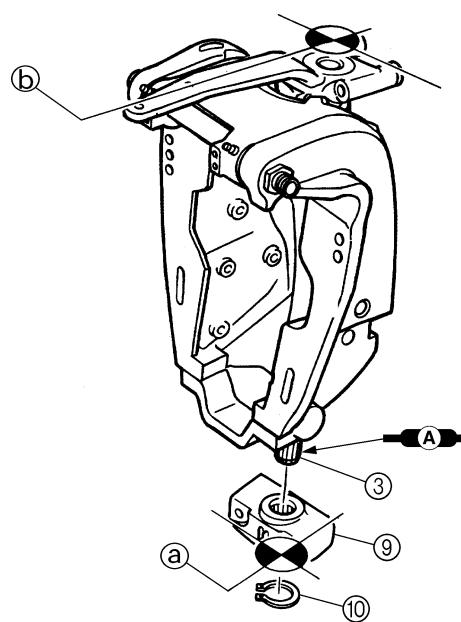
S69J7080

3. Install the bushing ⑤, O-ring ⑥, bushing ⑦, and washer ⑧ onto the swivel bracket.



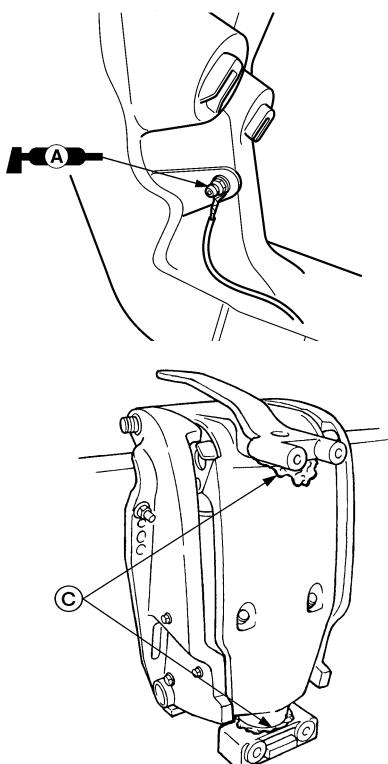
S69J7085

4. Install the steering arm ③ into the steering yoke ⑨ by aligning the center ⑩ of the yoke with the center ⑪ of the steering arm.
5. Install the circlip ⑩.



S69J7090

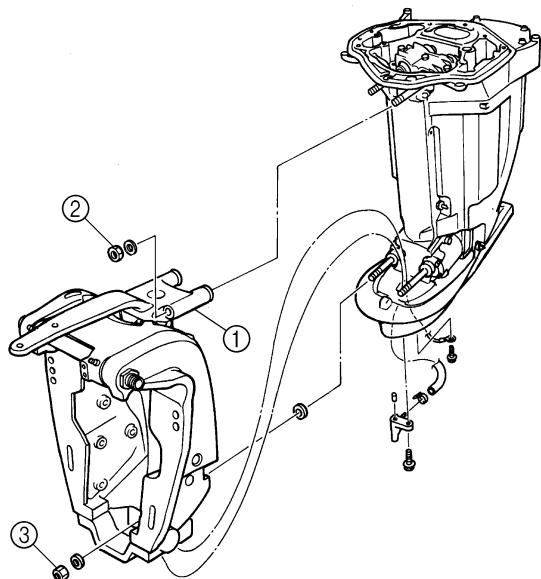
6. Inject grease into the grease nipple until grease comes out from both the upper and lower bushings ⑫.



S69J7095

**BRKT****Bracket unit****Installing the upper case**

1. Install the upper and lower mounting bolts into the swivel bracket ① simultaneously.
2. Install the upper mounting nut ② and lower mounting nut ③, and then tighten them to the specified torques.

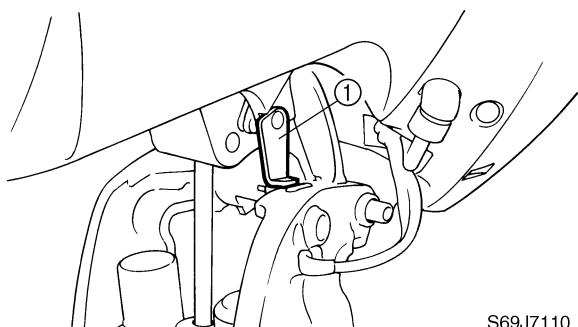


S69J7100

	Upper mounting nut ②: 72 N·m (7.2 kgf·m, 52 ft·lb)
	Lower mounting nut ③: 72 N·m (7.2 kgf·m, 52 ft·lb)

**Removing the power trim and tilt unit**

1. Fully tilt the outboard motor up, and then support it with the tilt stop lever ①.



S69J7110

**WARNING**

After tilting up the outboard motor, be sure to support it with the tilt stop lever. Otherwise, the outboard motor could suddenly lower if the power trim and tilt unit should lose fluid pressure.

**NOTE:**

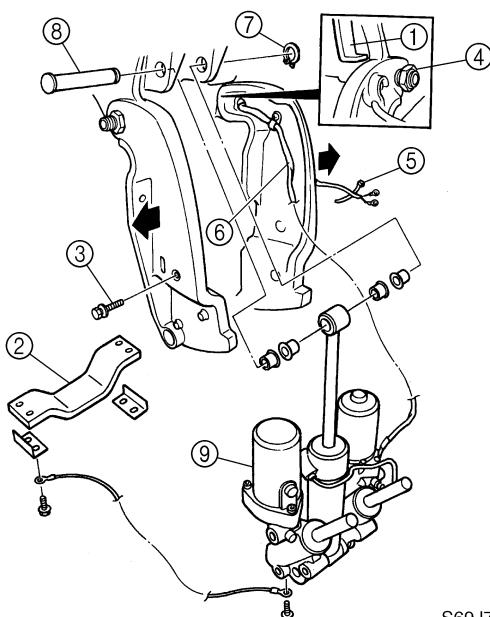
If the power trim and tilt does not operate, loosen the manual valve and tilt the outboard motor up manually.

2. Remove the anode ② and bolts ③.
3. Loosen the self-locking nut ④, and then move the clamp brackets slightly in the direction of the arrows.

**WARNING**

Do not remove the tilt stop lever ① from the clamp brackets.

4. Remove the plastic ties ⑤, and then pull out the PTT motor lead ⑥.
5. Remove the circlip ⑦, then the shaft ⑧.
6. Remove the power trim and tilt unit ⑨.

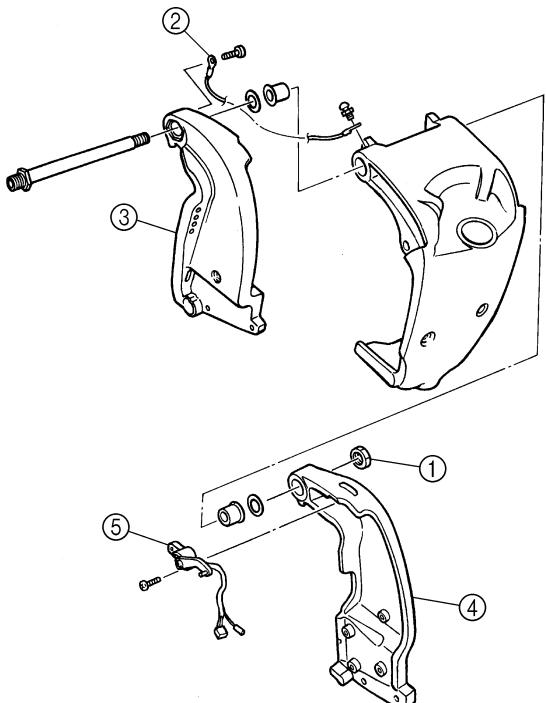


S69J7115

## Upper case, steering arm, swivel bracket and clamp brackets

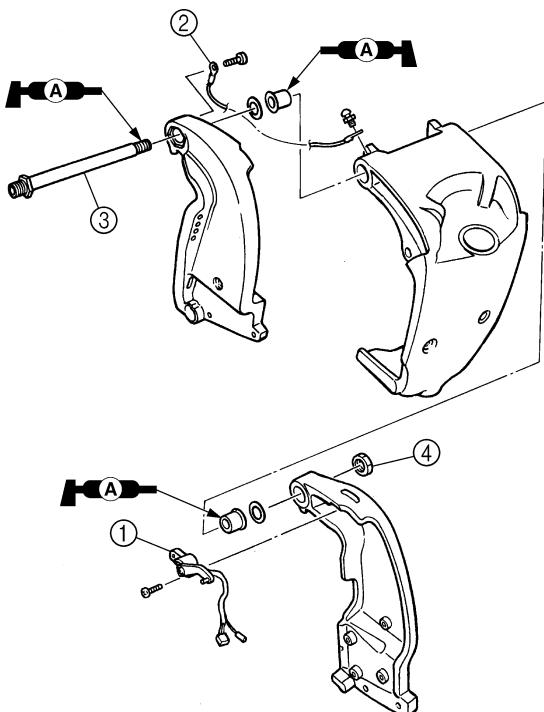
### Removing the clamp brackets

1. Remove the self-locking nut ① and ground lead ②, then clamp brackets ③ and ④.
2. Remove the trim sensor ⑤.



S69J7120

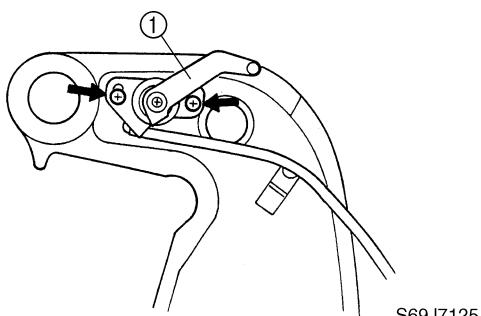
2. Assemble the clamp brackets and the swivel bracket by connecting the ground lead ②, installing the through tube ③, then tightening the self-locking nut ④ finger tight.



S69J7130

### Installing the clamp brackets

1. Install the trim sensor ① onto the port clamp bracket.



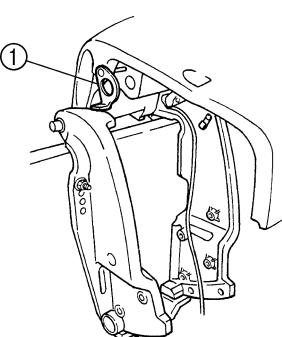
S69J7125

#### NOTE:

Adjust the trim sensor after installing the power trim and tilt unit.

### Installing the power trim and tilt unit

1. Fully tilt the outboard motor up, and then support it with the tilt stop lever ①.



S69J7135

7

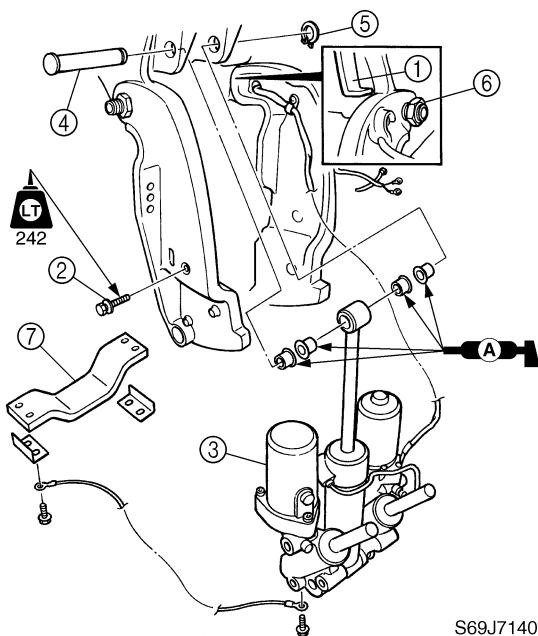
#### NOTE:

After tilting up the outboard motor, be sure to support it with the tilt stop lever.

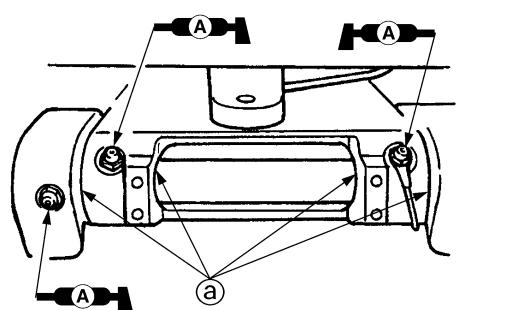
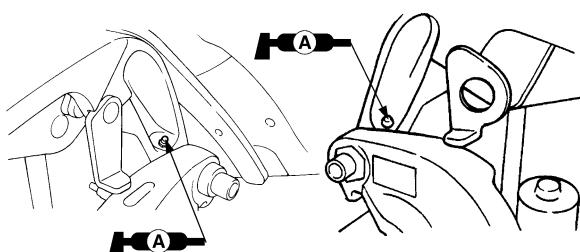
2. Install the bolts ② onto both clamp brackets together with the power trim and tilt unit ③.

**BRKT****Bracket unit**

3. Install the tilt ram upper end into the swivel bracket with the shaft ④ and circlip ⑤.
4. Tighten the self-locking nut ⑥ to the specified torque.
5. Remove the anode ⑦.



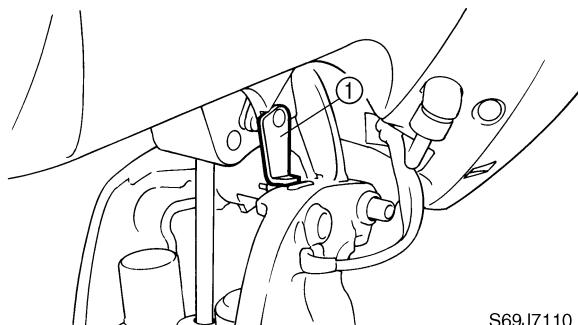
6. Inject grease into all grease nipples until grease comes out from the bushings ⑧.



S69J7145

**Adjusting the trim sensor**

1. Fully tilt the outboard motor up, and then support it with the tilt stop lever ①.



S69J7110

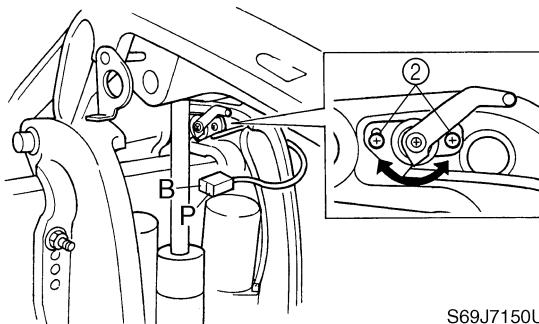
**WARNING**

**After tilting up the outboard motor, be sure to support it with the tilt stop lever. Otherwise, the outboard motor could suddenly lower if the power trim and tilt unit should lose fluid pressure.**

2. Loosen the cam screws ②.
3. Adjust the position of the trim sensor, and then tighten the screws ② finger tight.
4. Fully tilt the outboard motor down.
5. Measure the trim sensor resistance. Repeat steps 1–5 if out of specification.

	Trim sensor resistance: Pink (P) – Black (B) 9–11 Ω at 20 °C (68 °F)
--	--

6. Tighten the screws ②.



S69J7150U

## **Upper case, steering arm, swivel bracket and clamp brackets**

7. Fully tilt the outboard motor up, and then support it with the tilt stop lever.

### **⚠ WARNING**

**After tilting up the outboard motor, be sure to support it with the tilt stop lever. Otherwise, the outboard motor could suddenly lower if the power trim and tilt unit should lose fluid pressure.**

8. Measure the trim sensor resistance. Check the trim sensor if out of specification.



Trim sensor resistance:

Pink (P) – Black (B)

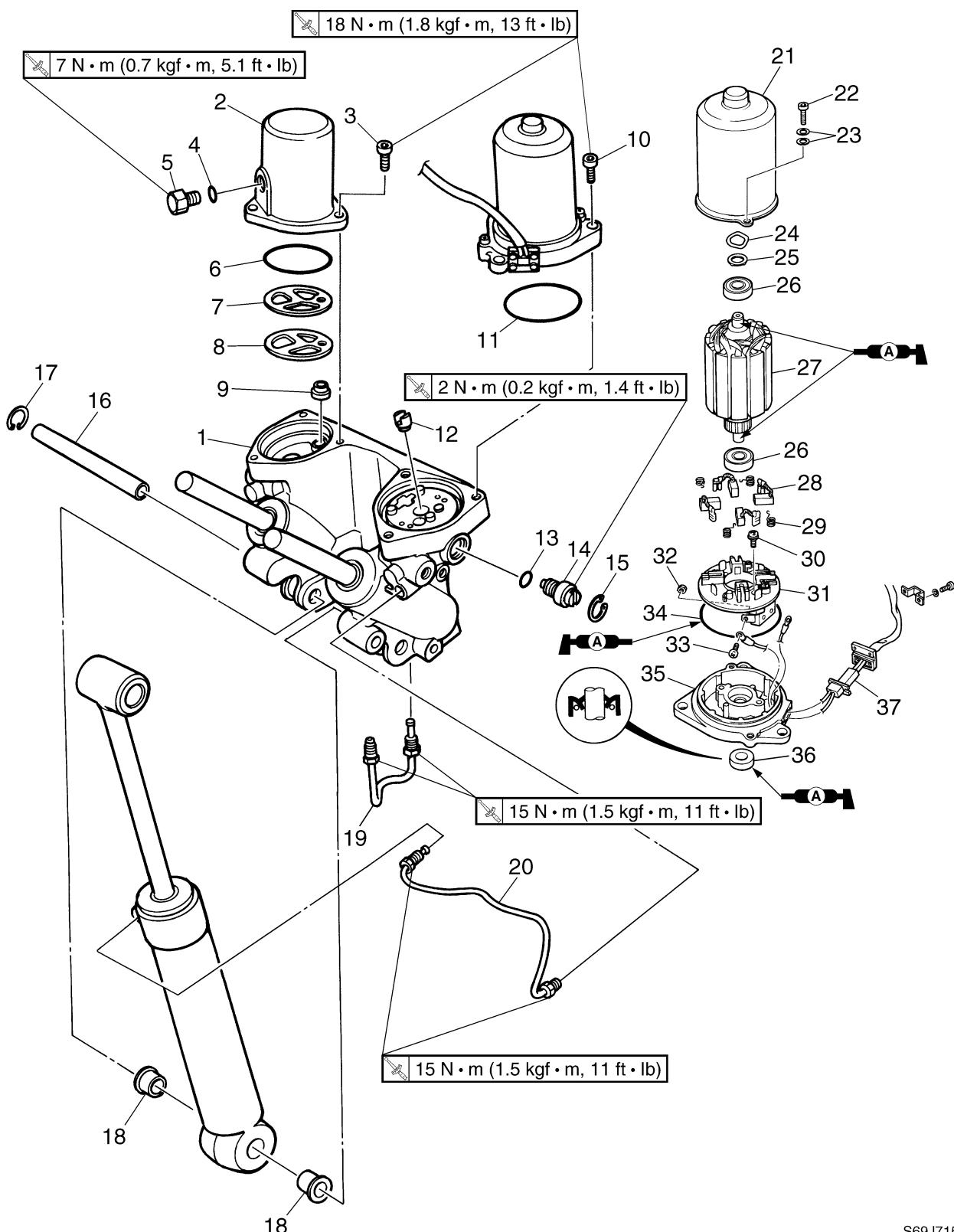
247.6–387.6 Ω at 20 °C (68 °F)

BRKT



Bracket unit

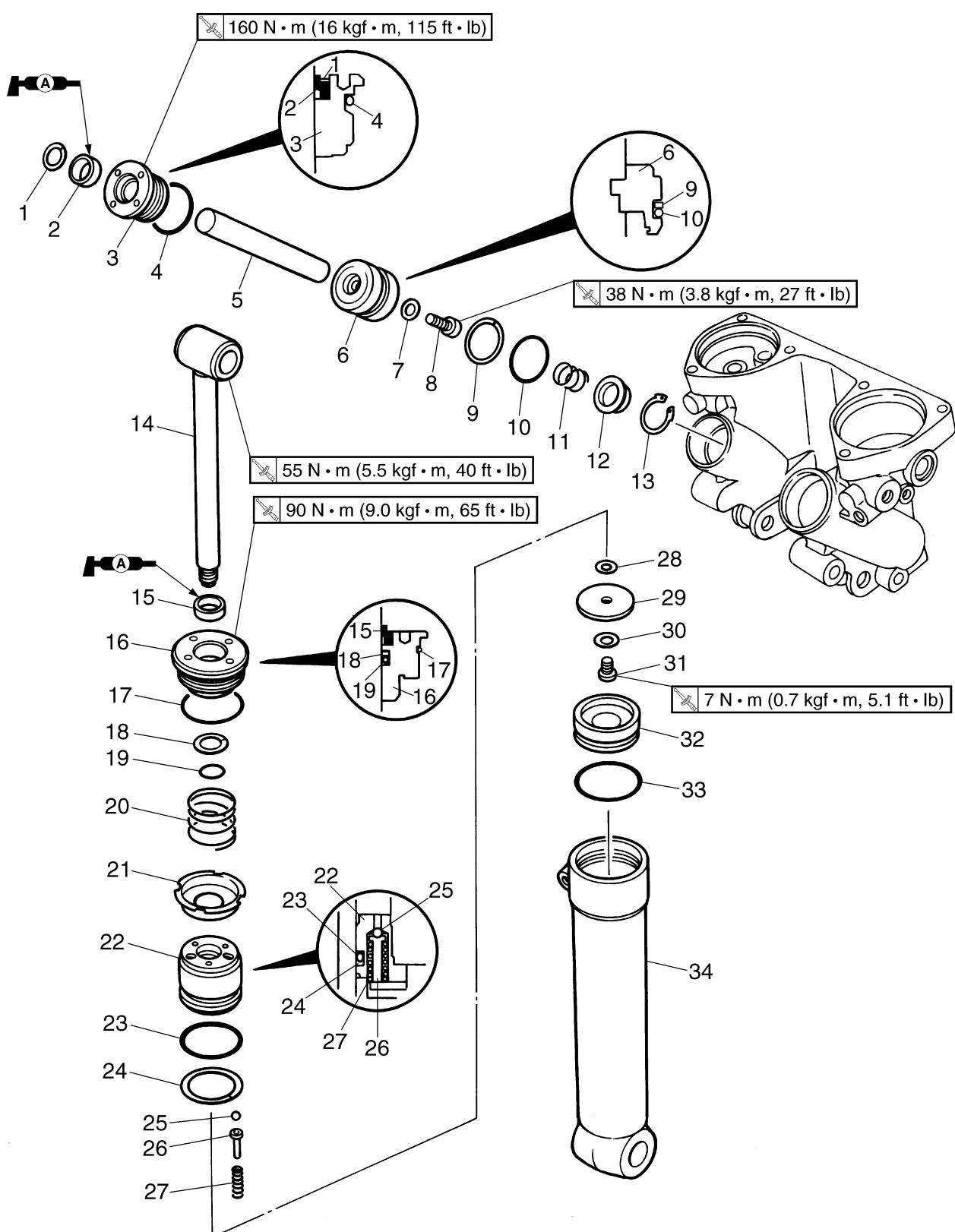
## Power trim and tilt unit



S69J7155

## Power trim and tilt unit

No.	Part name	Q'ty	Remarks
1	Cylinder block	1	
2	Reservoir	1	
3	Bolt	3	M8 × 20 mm
4	O-ring	1	<b>Not reusable</b> 1.9 × 12.6 mm
5	Reservoir cap	1	M12 × 10 mm
6	O-ring	1	<b>Not reusable</b>
7	Sheet	1	
8	Filter	1	
9	Spacer	1	
10	Bolt	3	M8 × 20 mm
11	O-ring	1	<b>Not reusable</b> 2.4 × 22.6 mm
12	Joint	1	
13	O-ring	1	<b>Not reusable</b>
14	Manual valve	1	
15	Circlip	1	
16	Shaft	1	
17	Circlip	1	
18	Bushing	2	
19	Pipe	1	
20	Pipe	1	
21	Yoke	1	
22	Bolt	2	M5 × 12 mm
23	Washer	4	
24	Wave washer	1	
25	Washer	1	
26	Bearing	2	
27	Armature	1	
28	Brush	4	
29	Spring	4	
30	Screw	2	M4 × 12 mm
31	Brush holder	1	
32	Nut	2	
33	Screw	2	M4 × 6 mm
34	O-ring	1	<b>Not reusable</b>
35	PTT motor base	1	
36	Oil seal	1	<b>Not reusable</b>
37	PTT motor lead	1	

**BRKT****Bracket unit**

S69J7165

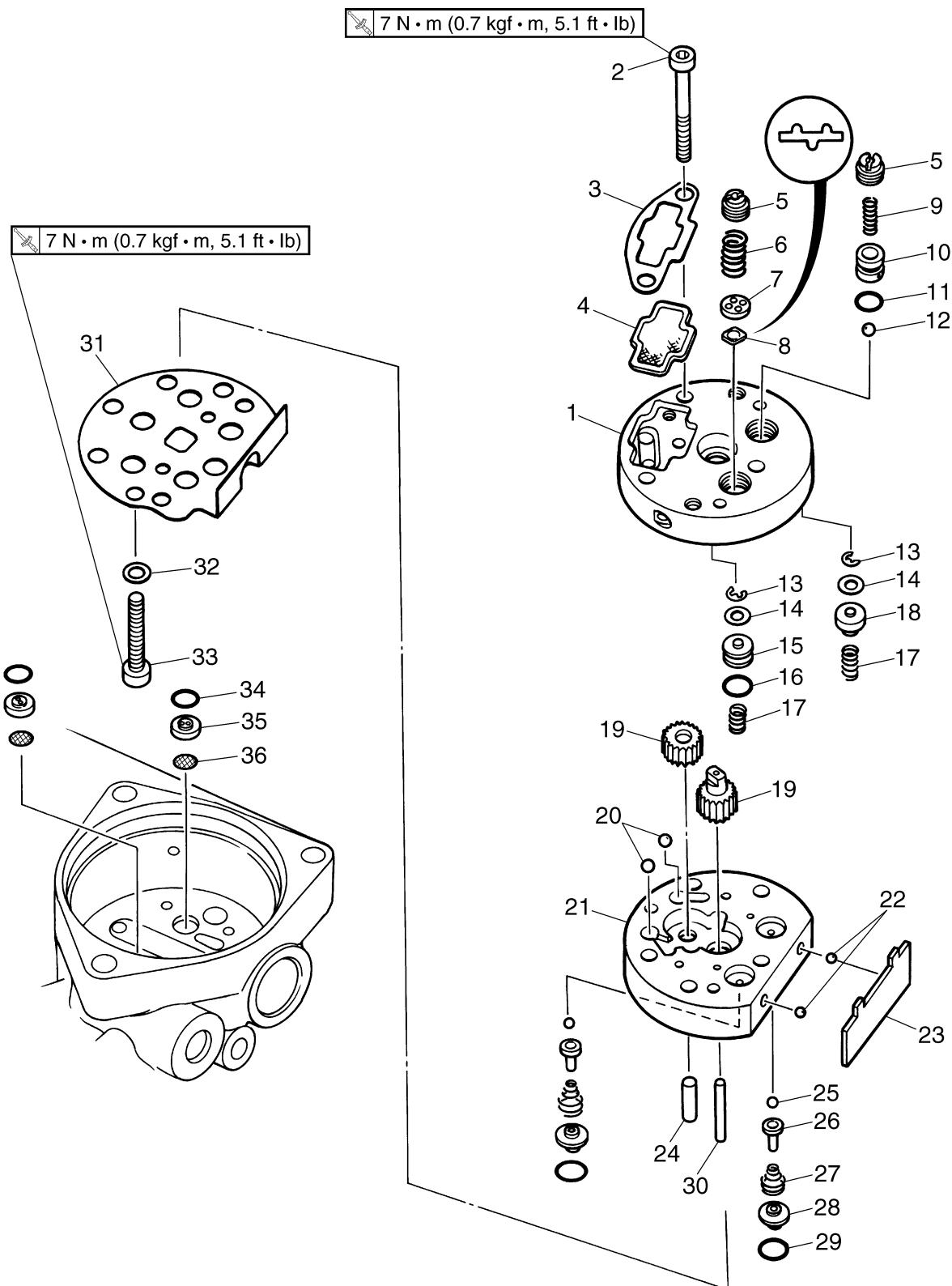
## Power trim and tilt unit

No.	Part name	Q'ty	Remarks
1	Circlip	2	
2	Dust seal	2	Not reusable
3	Trim cylinder end screw	2	
4	O-ring	2	Not reusable
5	Trim ram	2	
6	Trim piston	2	
7	Washer	2	
8	Bolt	2	M8 × 20 mm
9	Backup ring	2	
10	O-ring	2	Not reusable
11	Spring	2	
12	Adapter	2	
13	Circlip	2	
14	Tilt ram	1	
15	Dust seal	1	Not reusable
16	Tilt cylinder end screw	1	
17	O-ring	1	Not reusable
18	Backup ring	1	
19	O-ring	1	Not reusable
20	Spring	1	
21	Adapter	1	
22	Tilt piston	1	
23	O-ring	1	Not reusable
24	Backup ring	1	
25	Ball	5	
26	Pin	5	
27	Spring	5	
28	Washer	1	
29	Plate	1	
30	Washer	1	
31	Bolt	1	M6 × 10 mm
32	Free piston	1	
33	O-ring	1	Not reusable
34	Tilt cylinder	1	

BRKT



Bracket unit



S69J7170

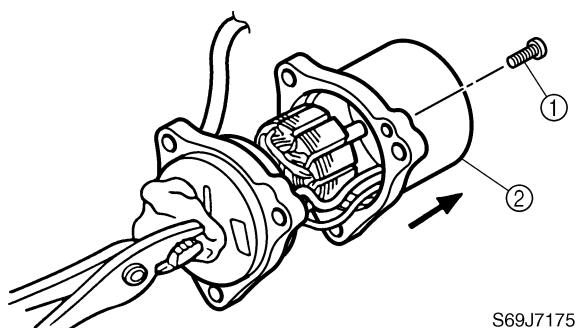
## Power trim and tilt unit

No.	Part name	Q'ty	Remarks
1	Gear housing 1	1	
2	Bolt	3	M5 × 40 mm
3	Plate	1	
4	Filter	1	
5	Valve lock screw	2	
6	Down-relief spring	1	
7	Valve support pin	1	
8	Relief valve seal	1	
9	Up-relief spring	1	
10	Valve support pin	1	
11	O-ring	1	<b>Not reusable</b> 1.8 × 11.35 mm
12	Ball	1	
13	Circlip	2	
14	Main valve seal	2	
15	Shuttle piston	1	
16	O-ring	1	<b>Not reusable</b>
17	Return spring	2	
18	Shuttle piston	1	
19	Drive gear	2	
20	Ball	2	
21	Gear housing 2	1	
22	Ball	2	
23	Manual release spring	1	
24	Dowel pin	1	
25	Ball	2	
26	Pin	2	
27	Spring	2	
28	Spacer	2	
29	O-ring	2	<b>Not reusable</b> 1.9 × 9.6 mm
30	Dowel pin	2	
31	Bracket	1	
32	Washer	2	
33	Bolt	2	M5 × 25 mm
34	O-ring	2	<b>Not reusable</b> 1.9 × 9.6 mm
35	Spacer	2	
36	Filter	2	

**BRKT****Bracket unit**

### Disassembling the power trim and tilt motor

1. Remove the PTT motor screws ①, then the yoke ②.



S69J7175

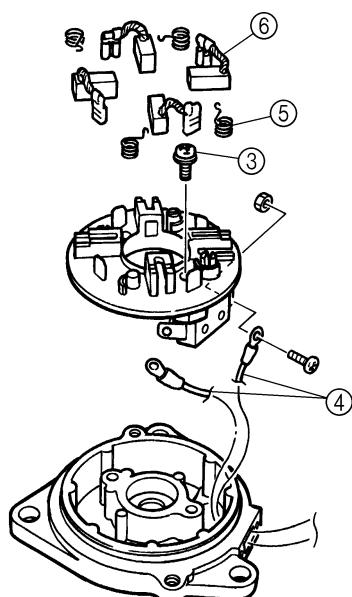
**CAUTION:**

**Do not allow grease or oil to contact the commutator.**

**NOTE:**

Place a clean cloth over the end of the armature shaft and carefully pull the armature from the yoke with a pair of pliers as shown.

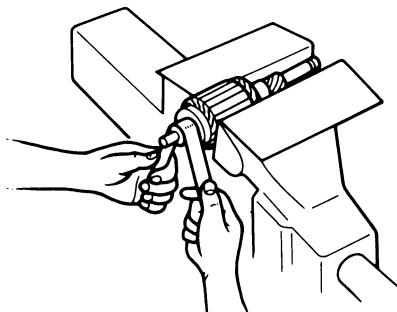
2. Remove the screws ③, disconnect the PTT motor leads ④, and then remove the springs ⑤ and brushes ⑥.



S69J7180

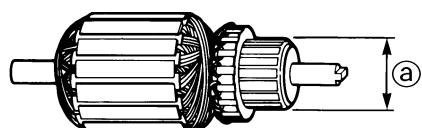
### Checking the power trim and tilt motor

1. Check the commutator for dirt or foreign substances. Clean with #600 grit sandpaper if necessary.



S69J7185

2. Check the commutator undercut for dirt or foreign substances. Clean with compressed air if necessary.
3. Measure the commutator diameter ⑦. Replace if out of specification.

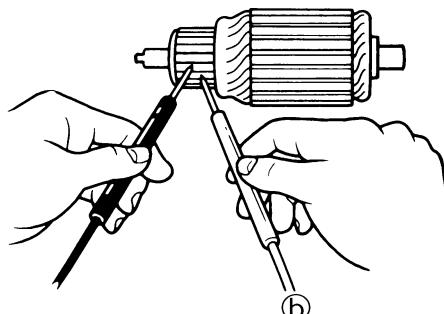


S69J7190



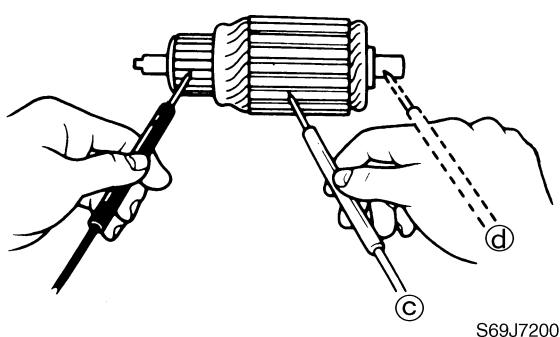
**Commutator diameter limit ⑦:**  
25.0 mm (0.98 in)

4. Check the armature coil for continuity. Replace if out of specifications.



S69J7195

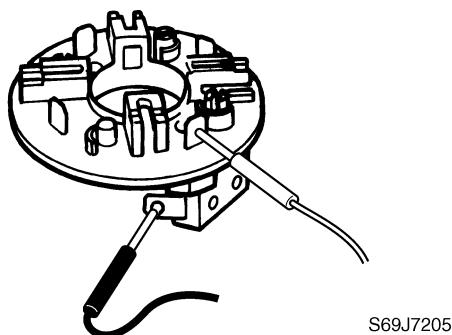
## Power trim and tilt unit



S69J7200

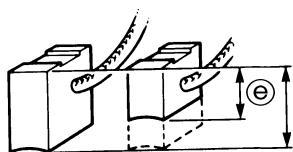
Armature coil continuity	
Commutator segments (b)	Continuity
Segment-laminations (c)	No continuity
Segment-shaft (d)	No continuity

5. Check the circuit breaker for continuity. Replace the brush holder if there is no continuity.



S69J7205

6. Measure the brush length. Replace if out of specification.



S69J7210

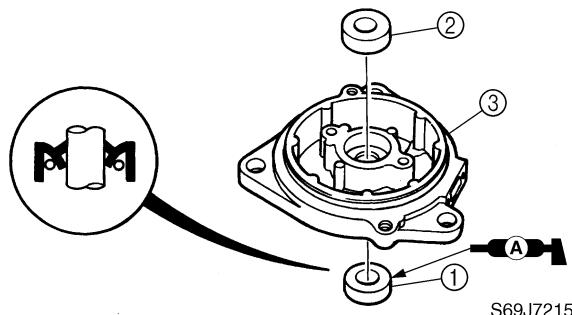
	Brush length limit (e): 4.0 mm (0.16 in)
--	---

7. Check the base for corrosion or damage. Replace if necessary.

8. Check the bearing for damage or wear. Replace if necessary.

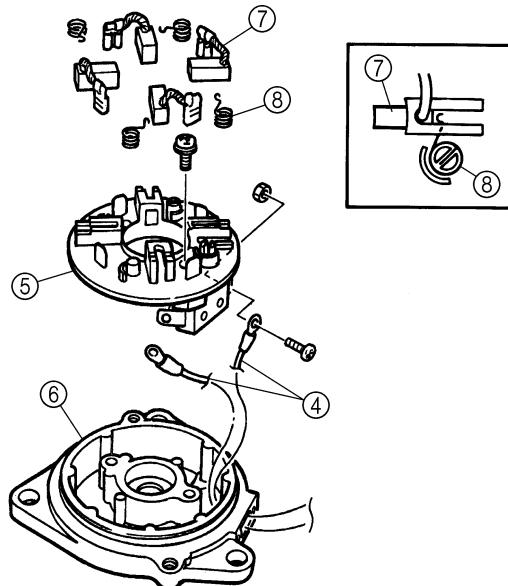
### Assembling the power trim and tilt motor

1. Install the new oil seal (1) and bearing (2) into the motor base (3) as shown.



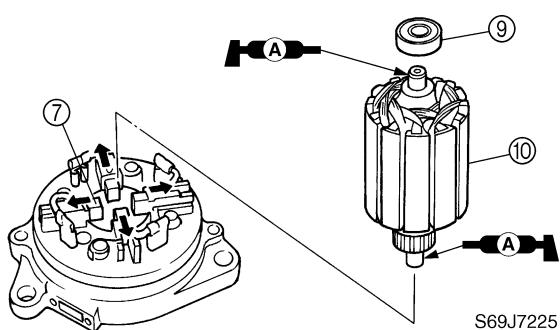
S69J7215

2. Connect the PTT motor leads (4) to the brush holder (5) and then install the brush holder (5) to the motor base (6).
3. Install the brushes (7) and springs (8) to the brush holder as shown.

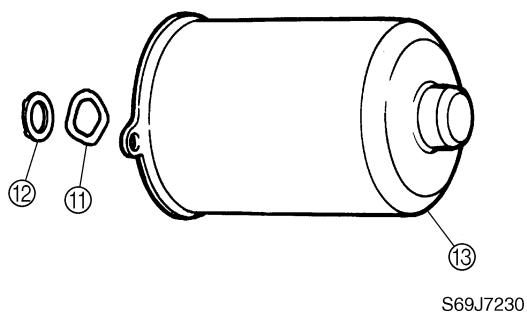


S69J7220

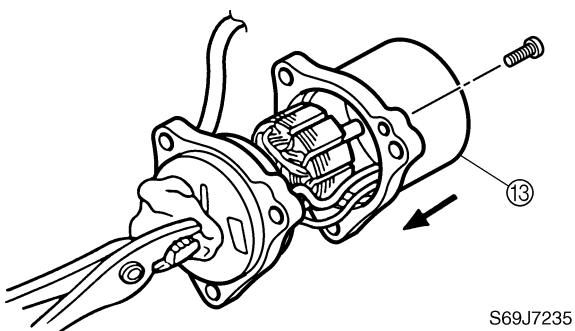
4. Install the bearing (9) to the armature (10).
5. Push the brushes (7) into the holders, and then install the armature (10).

**BRKT****Bracket unit**

6. Install the wave washer **(11)** and washer **(12)** into the yoke **(13)**.



7. Install the new O-ring and yoke **(13)** to the motor base.

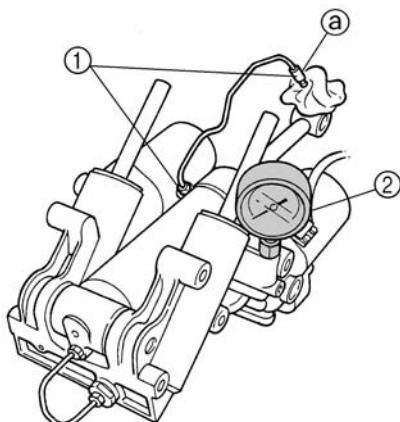
**NOTE:**

Place a clean cloth over the end of the armature shaft and carefully push the armature from the yoke with a pair of pliers as shown.

**Checking the hydraulic pressure**

1. Check the hydraulic pressure. Check the internal parts if out of specification.
2. Fully extend the power trim and tilt rams.
3. Loosen the pipe joints **(1)**, and then remove the pipe joint **(a)**.

4. Install the PTT oil pressure gauge adapter set **(2)**.

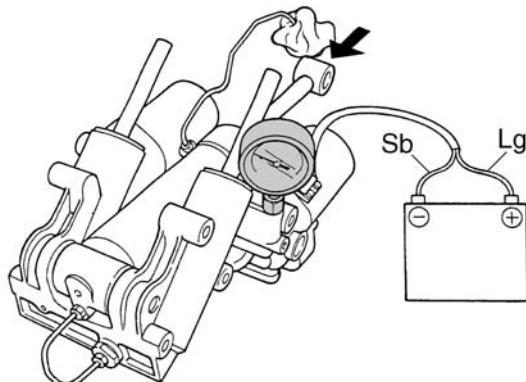
**NOTE:**

Cover the removed pipe joint **(a)** with a rag.



**PTT oil pressure gauge adapter set:**  
**YB-06580**

5. Connect the PTT motor leads to the battery terminals to retract the tilt ram, and then measure the hydraulic pressure.



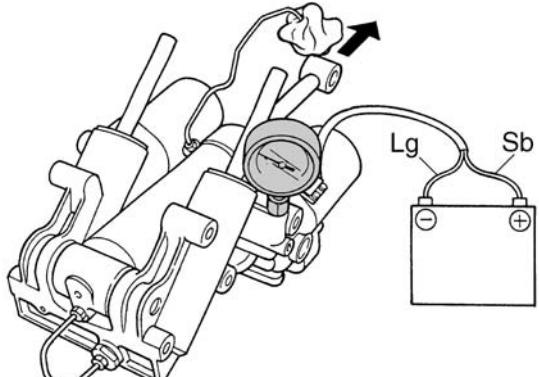
Ram	PTT motor lead	Battery terminal
Down	Light green (Lg) Sky blue (Sb)	⊕ ⊖



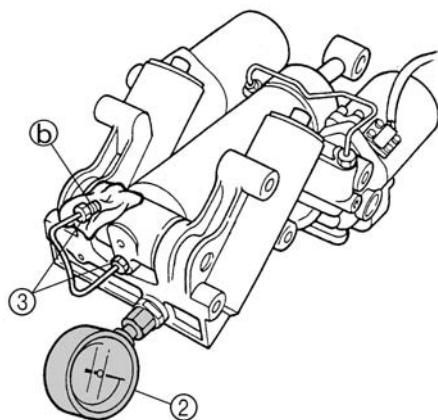
**Hydraulic pressure (down):**  
**6.7–8.7 MPa (68–89 kgf/cm<sup>2</sup>)**

## Power trim and tilt unit

6. Reverse the PTT motor leads between the battery terminals to fully extend the trim and tilt rams.



S69J7250



S69J7255

**NOTE:**

Cover the removed pipe joint (b) with a rag.

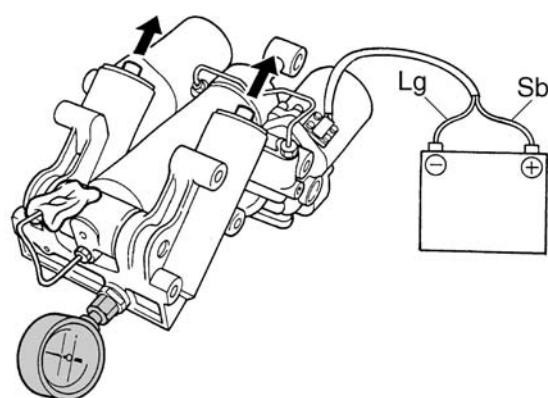


PTT oil pressure gauge adapter set:  
YB-06580

7. Remove the PTT oil pressure gauge adapter set ②.
8. Install the pipe joints ①, and then tightening them to the specified torque.

	Pipe joint ①: 15 N·m (1.5 kgf·m, 11 ft·lb)
--	---

9. Connect the PTT motor leads to the battery terminals to fully retract the trim and tilt rams.
10. Loosen the pipe joints ③, and then remove the pipe joint (b).
11. Install the PTT oil pressure gauge adapter set ②.



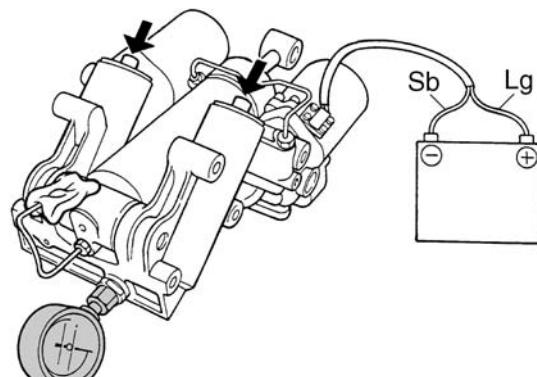
S69J7260



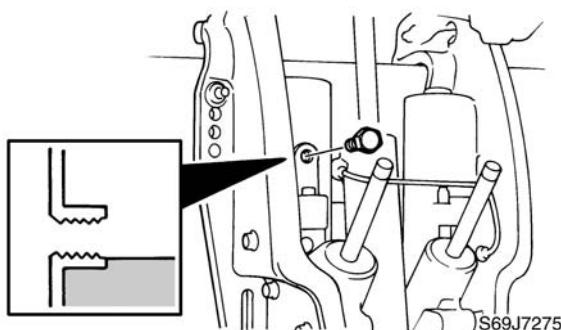
Hydraulic pressure (up):  
12.2–14.2 MPa (124–145 kgf/cm<sup>2</sup>)

7

13. Reverse the PTT motor leads between the battery terminals to fully retract the trim and tilt rams.

**BRKT****Bracket unit**

S69J7265



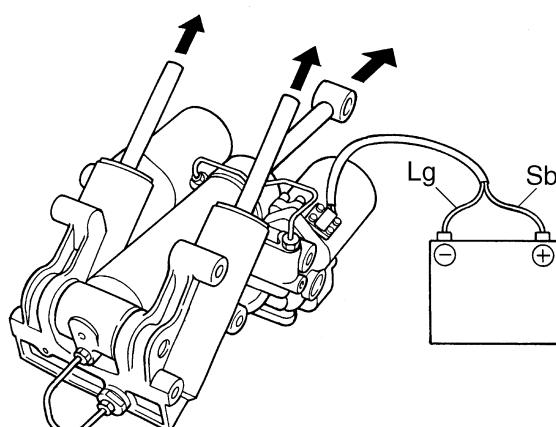
14. Remove the PTT oil pressure gauge adapter set ②.

15. Install the pipe joints ③, and then tightening them to the specified torque.



Pipe joint ③:  
15 N·m (1.5 kgf·m, 11 ft·lb)

16. After measuring the hydraulic pressure, connect the PTT motor leads to the battery terminals to fully extend the trim and tilt rams.



S69J7270

17. Remove the reservoir cap, and then check the fluid level in the reservoir.

18. If necessary, add fluid of the recommended type to the correct level.

**NOTE:**

If the fluid is at the correct level, the fluid should overflow out of the filler hole when the cap is removed.

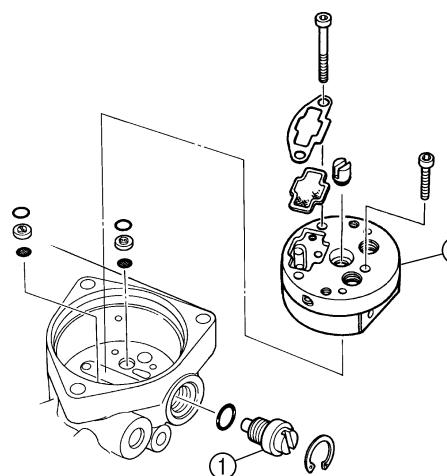


Recommended power trim and tilt fluid:  
ATF Dexron II

19. Install the reservoir cap.

**Disassembling the gear pump**

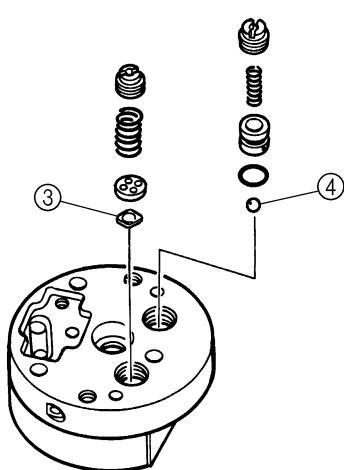
1. Remove the manual valve ① and gear pump ②.



S69J7280

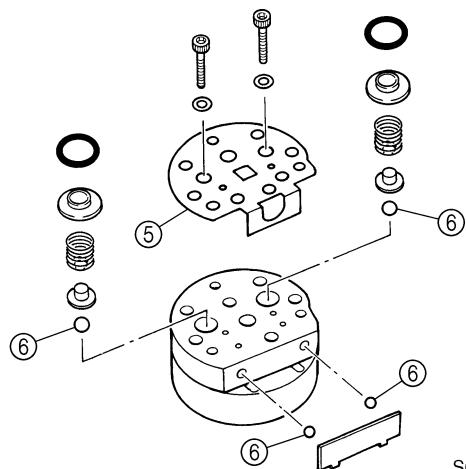
2. Remove the relief valve seal ③ and ball ④.

## Power trim and tilt unit



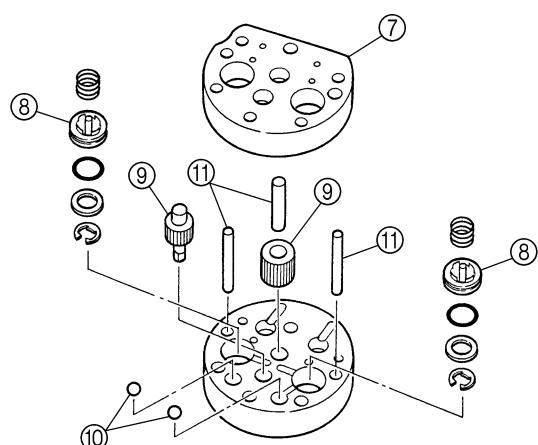
S69J7285

- Remove the bracket ⑤, then the balls ⑥.



S69J7290

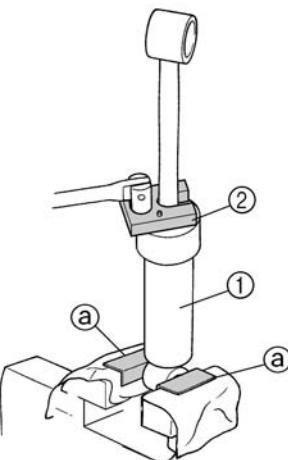
- Remove the gear housing 2 ⑦, then the shuttle pistons ⑧.
- Remove the drive gear ⑨, balls ⑩, and dowel pins ⑪.



S69J7295

### Disassembling the tilt cylinder and trim cylinders

- Hold the tilt cylinder ① in a vise using aluminum plates ② on both sides.
- Loosen the tilt cylinder end screw ③, and then remove the tilt piston assembly.



S69J7300

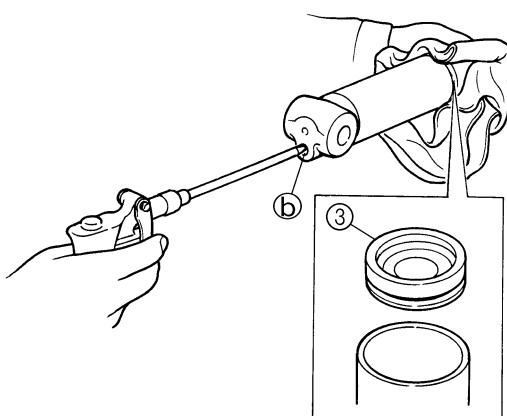
#### **WARNING**

Make sure that the rams are fully extended before removing the end screw.



Trim and tilt cylinder wrench:  
YB-06175-2B

- Drain the power trim and tilt fluid.
- Remove the free piston ③, and then blow compressed air through the hole ④ while holding down the cloth.

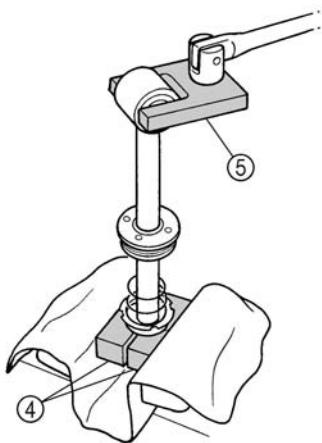


S69J7305

**BRKT****Bracket unit****⚠ WARNING**

Never look into the tilt cylinder opening because the free piston and power trim and tilt fluid may be expelled out forcefully.

5. Hold the tilt piston in a vise using the special service tool ④ on both sides.
6. Remove the tilt ram.



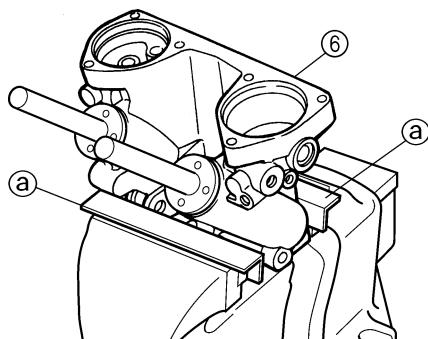
S69J7310



PTT piston vice attachment ④:  
YB-06572

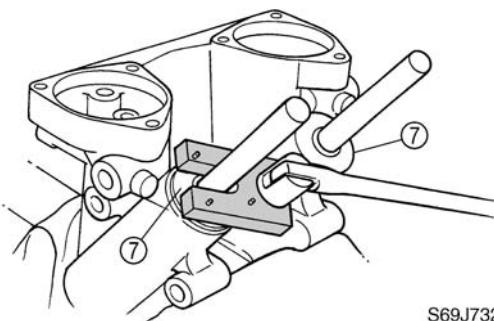
Tilt rod wrench ⑤: YB-06569

7. Hold the cylinder block ⑥ in a vise using aluminum plates ⑦ on both sides.



S69J7315

8. Loosen the trim cylinder end screws ⑦, and then remove them.

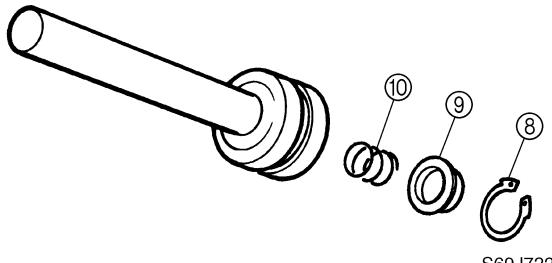


S69J7320



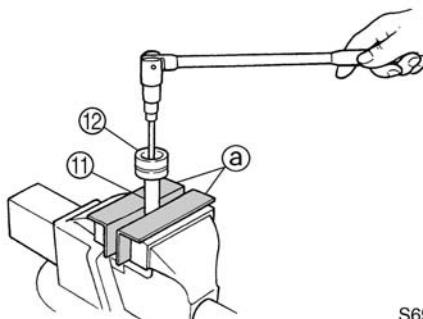
Trim and tilt cylinder wrench:  
YB-06175-2B

9. Remove the trim piston assemblies.
10. Drain the power trim and tilt fluid.
11. Remove the circlip ⑧, adapter ⑨, and spring ⑩ from the trim piston assemblies.



S69J7325

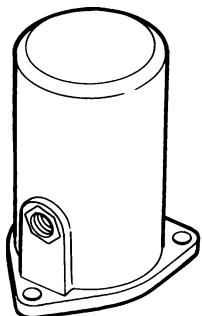
12. Hold the trim ram ⑪ in a vise using aluminum plates ⑫ on both sides.
13. Remove the trim piston ⑫.



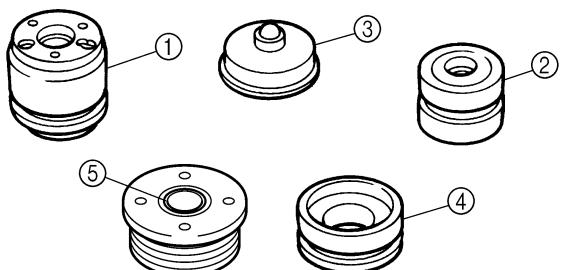
S69J7330

### Checking the reservoir

1. Check the reservoir for cracks or corrosion. Replace if necessary.



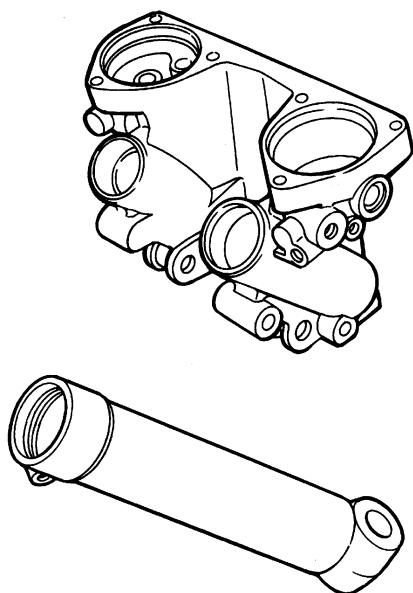
S69J7335



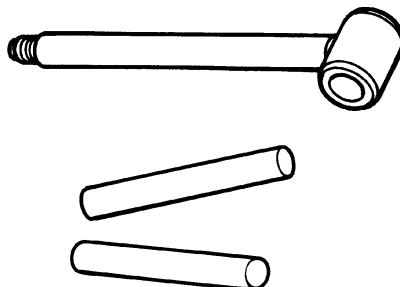
S69J7345

### Checking the tilt cylinder and trim cylinder

1. Check the power trim and tilt unit for cracks or corrosion. Replace if necessary.
2. Check the inner walls of the cylinder block and tilt cylinder for scratches. Replace if necessary.

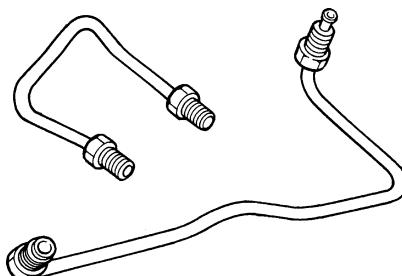


S69J7340



S69J7350

4. Check the trim and tilt rams for bends or excessive corrosion. Polish with #400–600 grit sandpaper if there is light rust or replace if necessary.



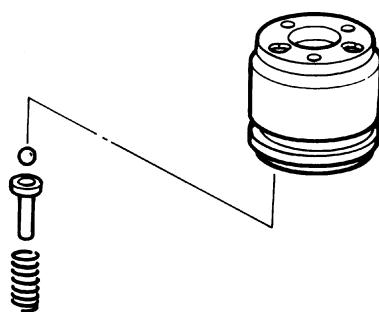
S69J7355

5. Check the pipes for cracks or corrosion. Replace if necessary.

3. Check the outer surface of the tilt piston ①, trim piston ②, adapter ③, free piston ④, and oil seal of end screw ⑤ for scratches. Replace if necessary.

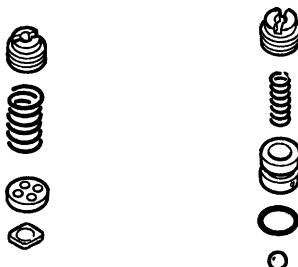
### Checking the valves

1. Check the operation of the tilt piston absorber valves and the valves for dirt or residue. Clean if necessary.

**BRKT****Bracket unit**

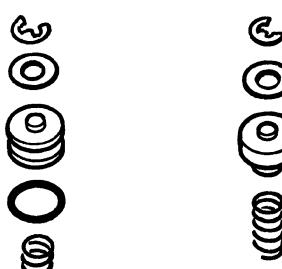
S69J7360

- Check the up-relief valve and down-relief valve for dirt or residue. Clean if necessary.



S69J7365

- Check the main valves for dirt or residue. Clean if necessary.



S69J7370

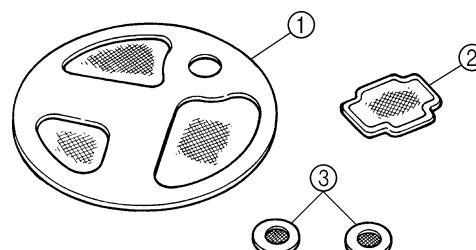
- Check the absorber valves for dirt or residue. Clean if necessary.



S69J7375

### **Checking the filters**

- Check gear pump filters ① and ②, and shuttle piston filters ③ for dirt or residue. Clean if necessary.



S69J7380

### **Checking the gear pump**

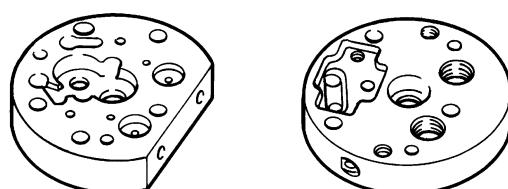
- Check the drive gear for damage or excessive wear. Replace if necessary.



S69J7385

### **Checking the gear pump housing**

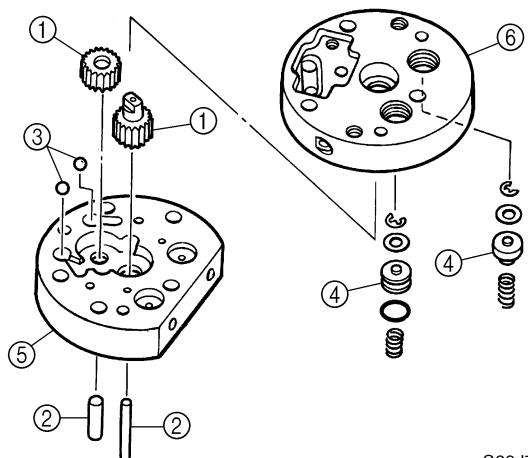
- Check the gear pump housing for scratches. Replace if necessary.



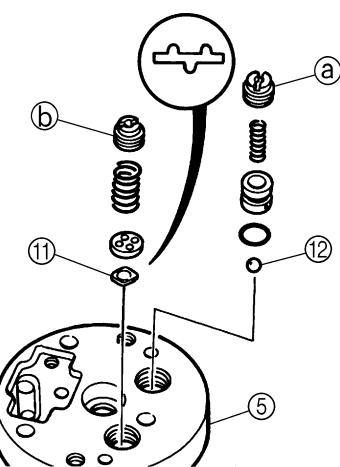
S69J7387

### **Assembling the gear pump**

- Install the drive gears ①, dowel pins ②, balls ③, and shuttle pistons ④ into the gear housing 1 ⑤.
- Install the gear housing 2 ⑥.

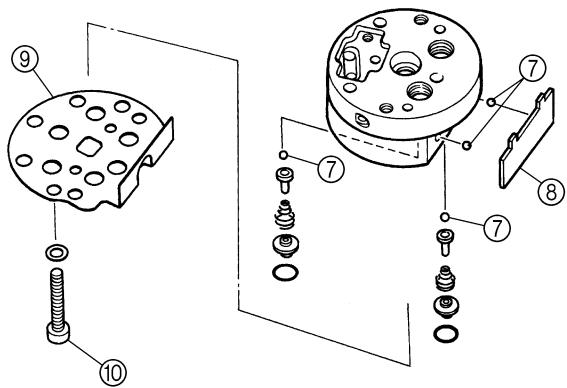


S69J7390



S60L7010

- Install the balls ⑦, manual release spring ⑧, and bracket ⑨ by installing the bolts ⑩, then tightening them to the specified torque.



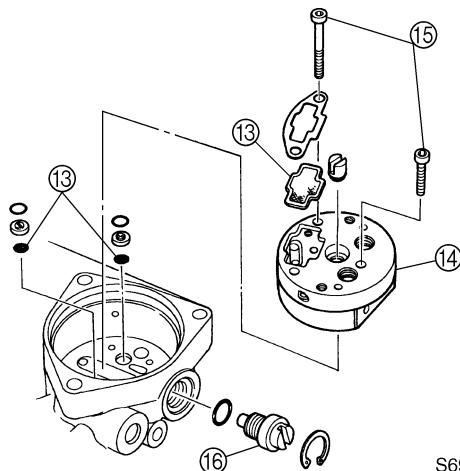
S69J7395

Gear pump bracket bolt ⑩:  
7 N·m (0.7 kgf·m, 5.1 ft·lb)

- Install the relief valve seal ⑪ and ball ⑫ into the gear housing 1 ⑤.

Up-relief lock screw ⑬ height  
(from the top of the gear housing):  
1.8–2.0 mm (0.071–0.079 in)  
Down-relief lock screw ⑭ depth  
(from the top of the gear housing):  
1.5–2.0 mm (0.059–0.079 in)

- Install the filters ⑯ and gear pump ⑰ by installing the bolts ⑮, then tightening them to the specified torque.
- Install the manual valve ⑯.

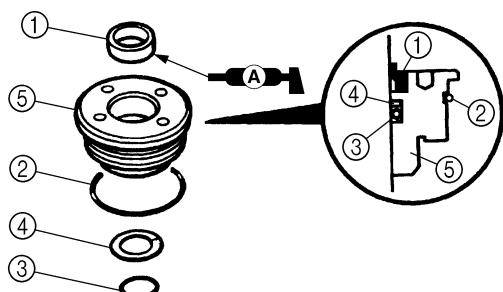


S69J7405

Gear pump bolt ⑮:  
7 N·m (0.7 kgf·m, 5.1 ft·lb)

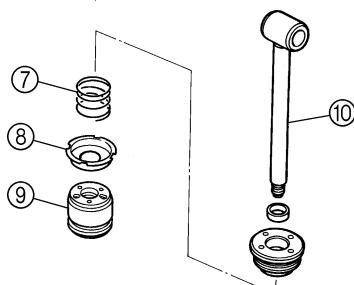
### Assembling the tilt ram

- Install the new dust seal ①, O-rings ② and ③, and backup ring ④ into the tilt cylinder end screw ⑤.

**BRKT****Bracket unit**

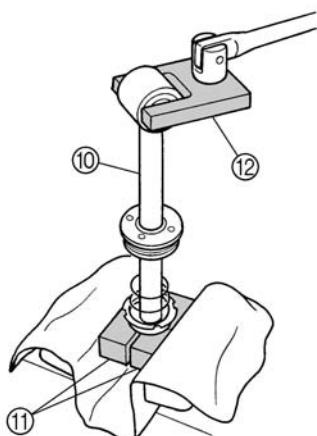
S69J7410

- Install the tilt cylinder end screw ⑥, spring ⑦, adapter ⑧, and tilt piston ⑨ to the tilt ram ⑤.



S69J7415

- Hold the tilt piston in a vise using the special service tool ⑪ on both sides.
- Tighten the tilt ram ⑩ to the specified torque.



S69J7420



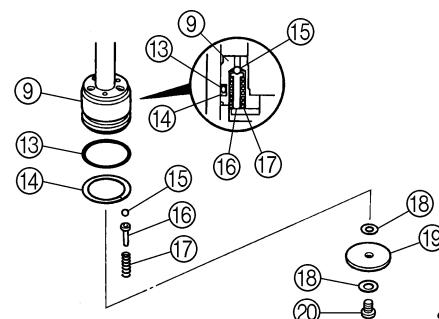
**PTT piston vice attachment ⑪:**  
YB-06572

**Tilt rod wrench ⑫:** YB-06569

**Tilt ram ⑩:**

55 N·m (5.5 kgf·m, 40 ft·lb)

- Install the new O-ring ⑬ and backup ring ⑭ into the tilt piston ⑨.
- Install the balls ⑮, absorber valve pins ⑯, and springs ⑰ as shown.
- Install the washers ⑱, plate ⑲, and bolt ⑳ to the tilt piston ⑨, and then tighten the bolt to the specified torque.



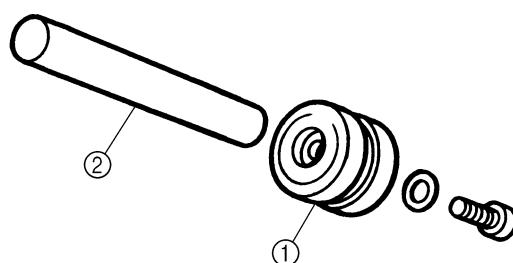
S69J7425

**Tilt piston bolt ⑳:**

7 N·m (0.7 kgf·m, 5.1 ft·lb)

**Assembling the trim rams**

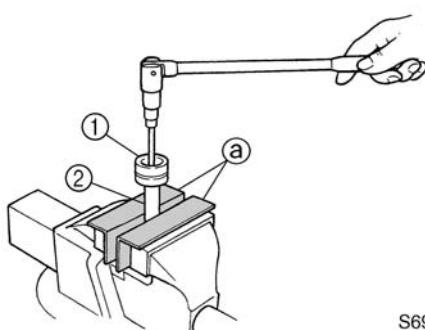
- Install the trim piston ① to the trim ram ②.



S69J7430

- Hold the trim ram ② in a vise using aluminum plates ③ on both sides.
- Tighten the trim piston bolt to the specified torque.

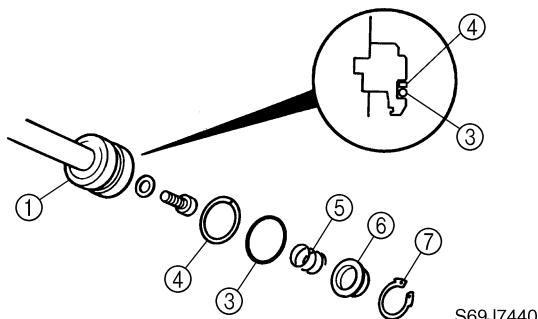
## Power trim and tilt unit



S69J7435

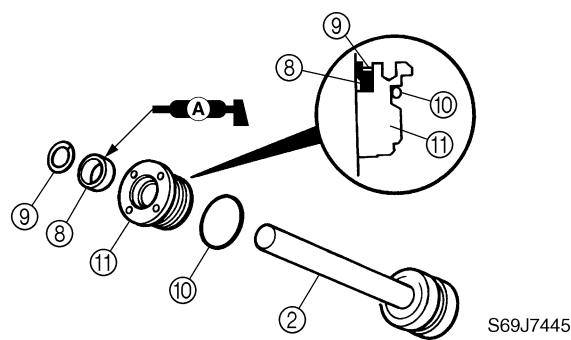


- Install the new O-ring (3), backup ring (4), spring (5), adapter (6), and circlip (7) to the trim piston (1).



S69J7440

- Install the new oil seal (8), circlip (9), and new O-ring (10) into the trim cylinder end screw (11).
- Install the trim cylinder end screw (11) into the trim ram (2).



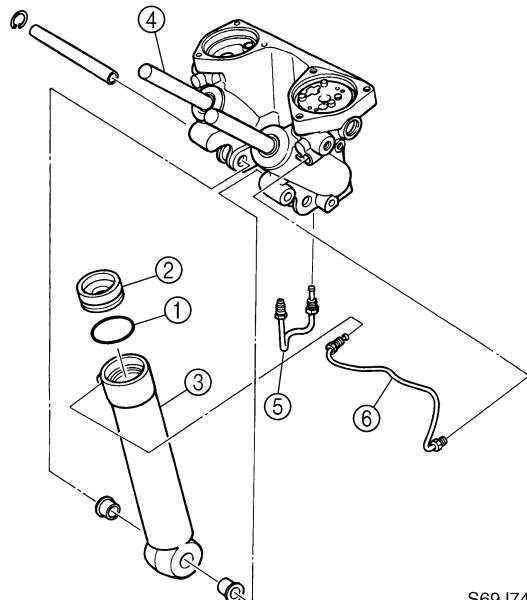
S69J7445

### Installing the tilt cylinder

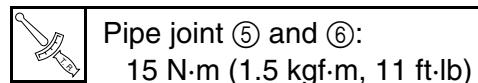
- Install the new O-ring (1) to the free piston (2).
- Push the free piston (2) into the tilt cylinder (3) until it bottoms out.

- Install the tilt cylinder (3) to the cylinder block (4).

- Install pipes (5) and (6), and then tighten them to the specified torque.

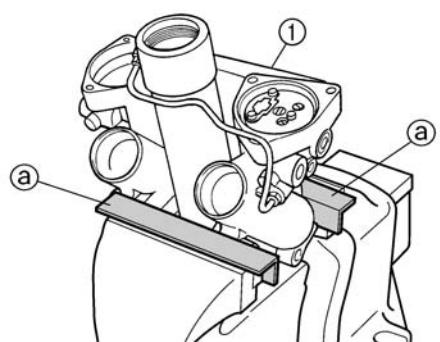


S69J7450



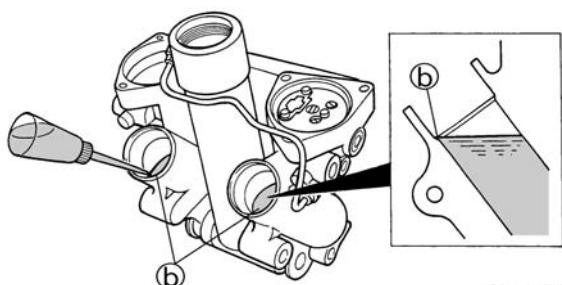
### Installing the trim rams

- Hold the cylinder block (1) in a vise using aluminum plates (a) on both sides.

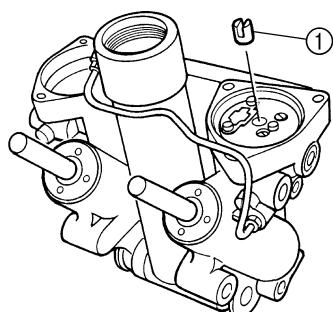


S69J7455

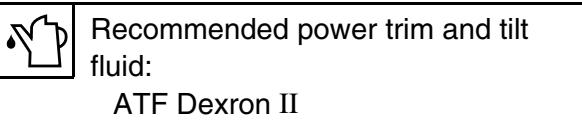
- Fill the trim cylinders with the recommended fluid to the correct level (b) as shown.

**BRKT****Bracket unit**

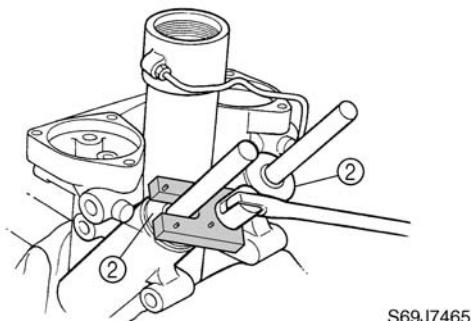
S69J7460



S69J7470



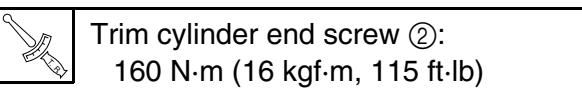
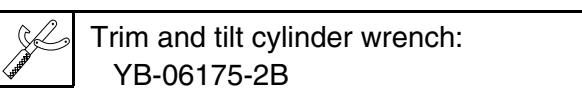
3. Install the trim piston assembly into the trim cylinder, and then tighten the trim cylinder end screw ② to the specified torque.



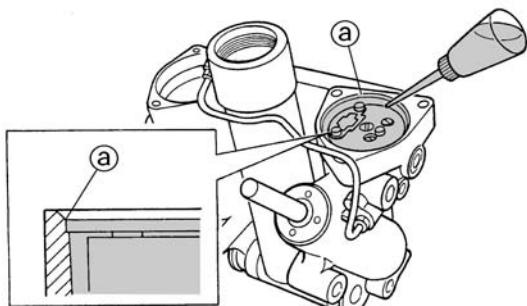
S69J7465

 **WARNING**

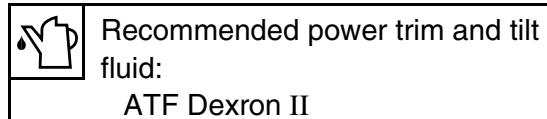
**Do not push the trim rams down while installing them into the trim cylinders. Otherwise, the power trim and tilt fluid may spurt out from the unit.**



2. Fill the pump housing with the recommended fluid to the correct level ① as shown.



S69J7475



3. Remove all of the air bubbles with a syringe or suitable tool.

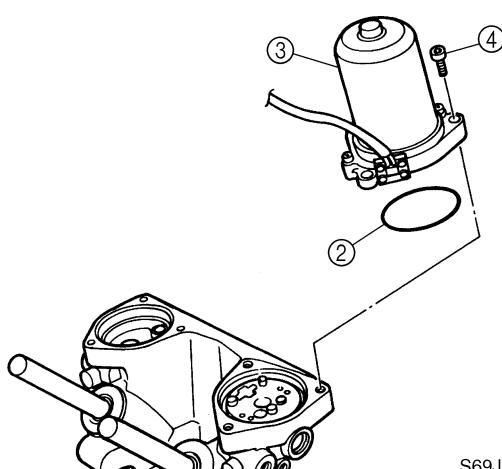
**NOTE:**

Turn the joint with a screwdriver, and then remove any air between the pump gear teeth.

4. Install the new O-ring ②, power trim and tilt motor ③, and then tighten the bolts ④ to the specified torque.

**Installing the power trim and tilt motor**

1. Install the joint ① into the pump housing.



S69J7480

**NOTE:**

Align the armature shaft with the recess in the joint.



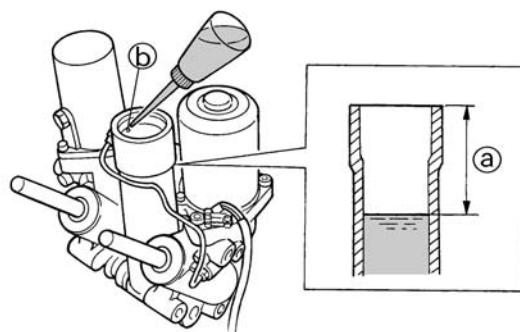
PTT motor bolt ④:  
18 N·m (1.8 kgf·m, 13 ft·lb)



Reservoir bolt ⑥:  
18 N·m (1.8 kgf·m, 13 ft·lb)  
Reservoir cap ⑦:  
7 N·m (0.7 kgf·m, 5.1 ft·lb)

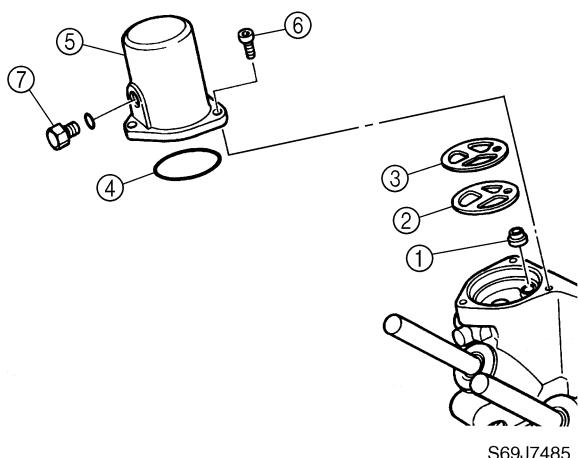
### Installing the tilt ram

1. Fill the tilt cylinder with the recommended fluid to the correct level ⑧ as shown.
2. Add a small amount of the recommended fluid through the cylinder block hole ⑨ as shown.



### Installing the reservoir

1. Install the spacer ①, filter ② and sheet ③ to the cylinder block.
2. Install the new O-ring ④ and reservoir ⑤, and then tighten the bolts ⑥ to the specified torque.
3. Install the reservoir cap ⑦, and then tighten it to the specified torque.



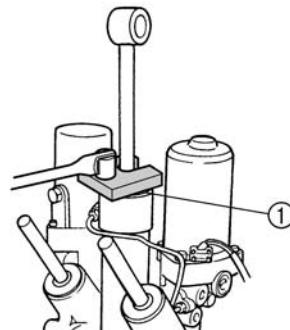
S69J7485



Recommended power trim and tilt fluid:  
ATF Dexron II

7

3. Install the tilt piston assembly into the tilt cylinder, and then tighten the tilt cylinder end screw ① to the specified torque.



S69J7495

**BRKT****Bracket unit****WARNING**

To prevent the power trim and tilt fluid from spouting out due to internal pressure, the tilt ram should be kept at full length.

**NOTE:**

Place the tilt cylinder end screw at the bottom of the tilt ram and install the tilt piston assembly into the tilt cylinder.



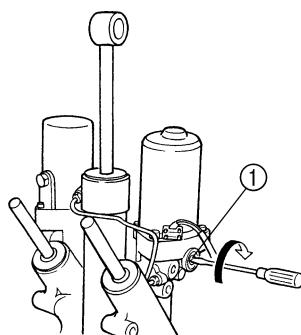
Trim and tilt cylinder wrench:  
YB-06175-2B



Trim cylinder end screw:  
90 N·m (9.0 kgf·m, 65 ft·lb)

**Bleeding the power trim and tilt unit****Not installed**

1. Tighten the manual valve ① by turning it clockwise.



S69J7500

2. Place the power trim and tilt unit in an upright position.

3. Check the fluid level in the reservoir.

**NOTE:**

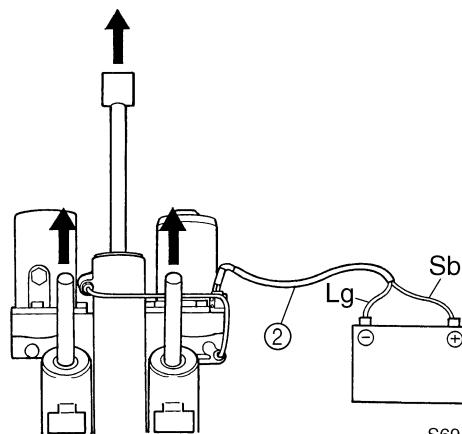
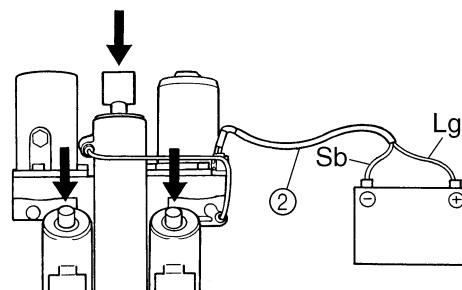
The fluid level should be at the brim of the filler hole.

4. If necessary, add sufficient fluid of the recommended type to the correct level.



Recommended power trim and tilt fluid:  
ATF Dexron II

5. Install the reservoir cap.
6. Connect the PTT motor leads ② to the battery terminals.



S69J7505

Ram	PTT motor lead	Battery terminal
Up	Sky blue (Sb)	⊕
	Light green (Lg)	⊖
Down	Light green (Lg)	⊕
	Sky blue (Sb)	⊖

7. Reverse the PTT motor leads between the battery terminals to fully extend the tilt ram and trim rams, and then reverse them again to fully retract the rams.

## Power trim and tilt unit / Bleeding the power trim and tilt unit

### NOTE:

- Repeat this procedure so that the rams go up and down four to five times (be sure to wait a few seconds before switching the leads).
- The sound of the power trim and tilt motor will change when the rams are fully extended.
- If the rams do not move up and down easily, push and pull on the rams to assist operation.

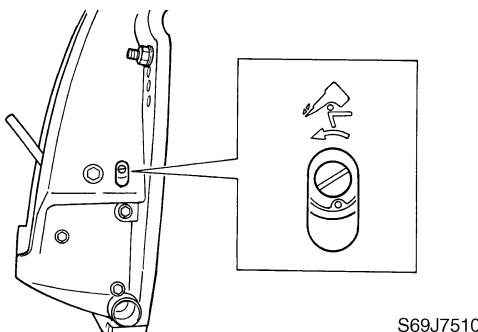
8. Check the fluid level again when the rams are fully extended. Add sufficient fluid, if necessary, and then repeat step 7.

### NOTE:

Repeat this procedure until the fluid remains at the correct level.

### Built-in

1. Loosen the manual valve by turning it counterclockwise until it cannot be turned further.



2. Fully tilt the outboard motor up, and then release it and let it lower by its own weight four to five times.
3. Tighten the manual valve by turning it clockwise.
4. Let the fluid settle for 5 minutes.
5. Push and hold the power trim and tilt switch in the up position until the outboard motor is fully tilted up.

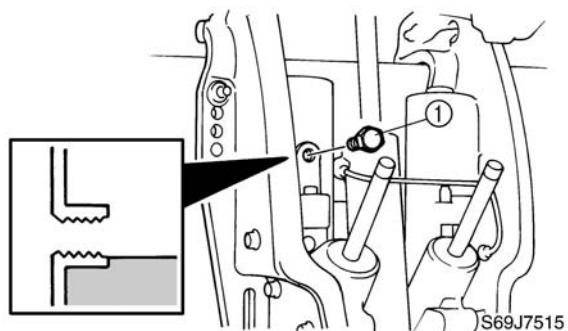
6. Support the outboard motor with the tilt stop lever, and then let the fluid settle for 5 minutes.

### WARNING

After tilting up the outboard motor, be sure to support it with the tilt stop lever. Otherwise, the outboard motor could suddenly lower if the power trim and tilt unit should lose fluid pressure.

7. Remove the reservoir cap ①, and then check the fluid level in the reservoir.

8. If necessary, add sufficient fluid of the recommended type to the correct level.



### NOTE:

If the fluid is at the correct level, the fluid should overflow out of the filler hole when the cap is removed.



Recommended power trim and tilt fluid:

ATF Dexron II

9. Install the reservoir cap.

### NOTE:

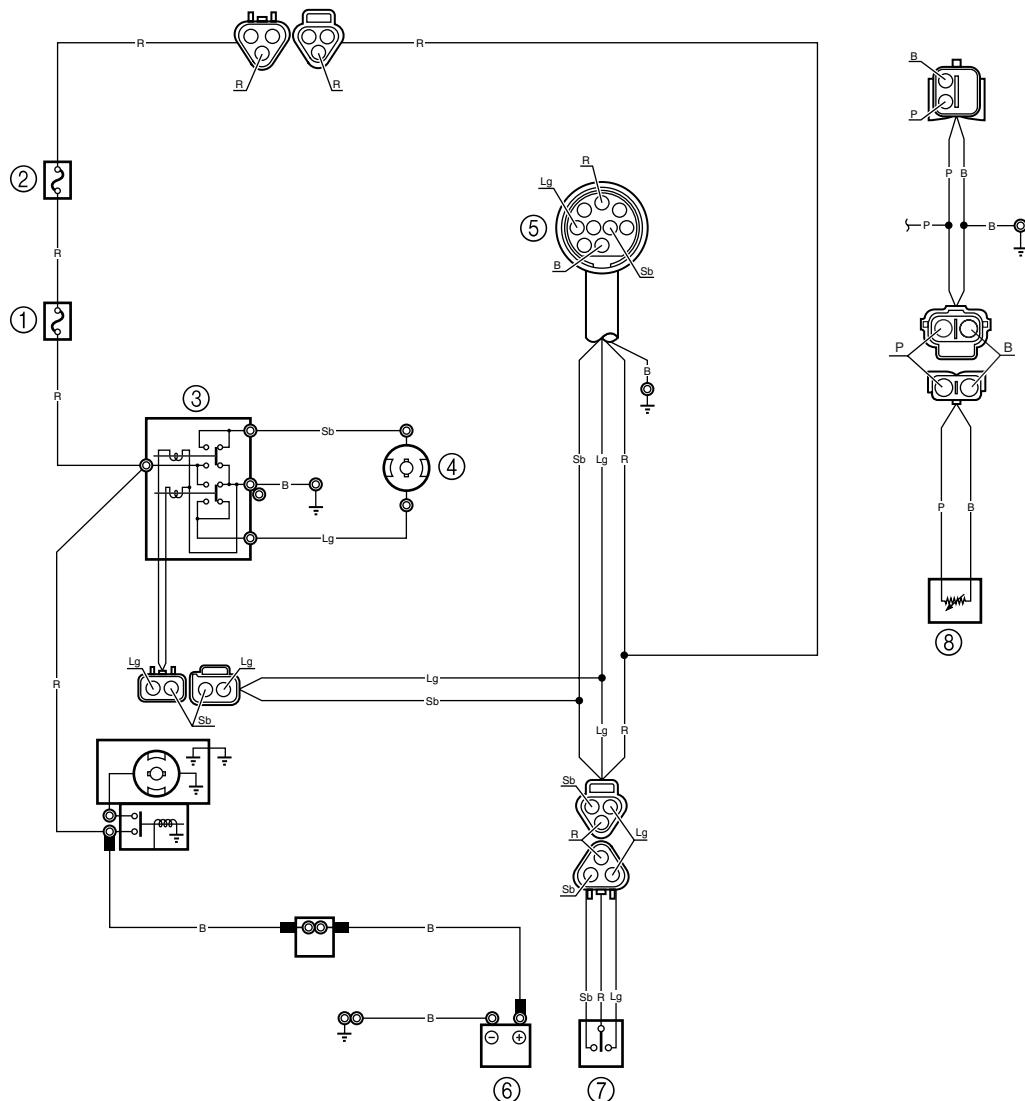
Repeat this procedure until the fluid remains at the correct level.

BRKT



Bracket unit

## Power trim and tilt electrical system



S69J17520U

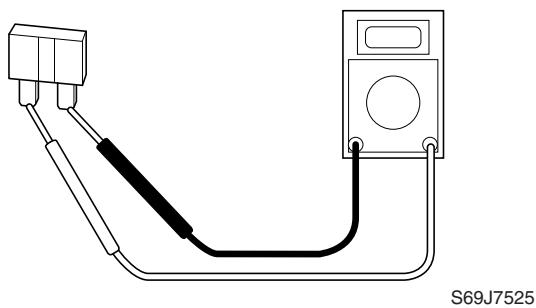
- ① Fuse (30 A)
- ② Fuse (20 A)
- ③ Power trim and tilt relay
- ④ Power trim and tilt motor
- ⑤ 10-pin coupler
- ⑥ Battery
- ⑦ Power trim and tilt switch
- ⑧ Trim sensor

- |    |               |
|----|---------------|
| B  | : Black       |
| Lg | : Light green |
| P  | : Pink        |
| R  | : Red         |
| Sb | : Sky blue    |

## Power trim and tilt electrical system

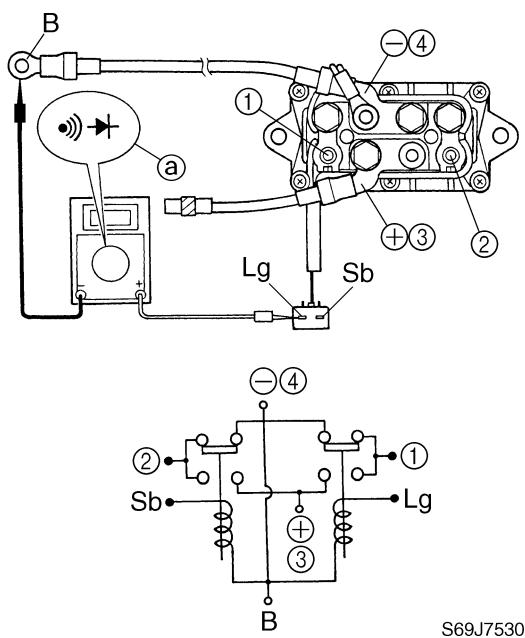
### Checking the fuse

1. Check the fuse for continuity. Replace if there is no continuity.



### Checking the power trim and tilt relay

1. Check the power trim and tilt relay for continuity. Replace if out of specification.

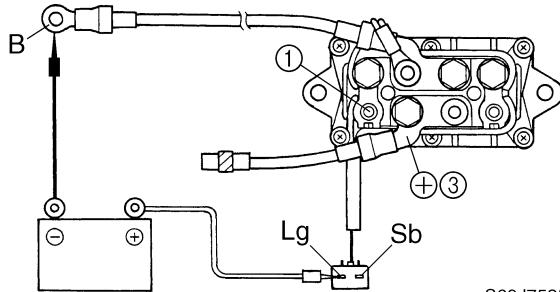


#### **NOTE:**

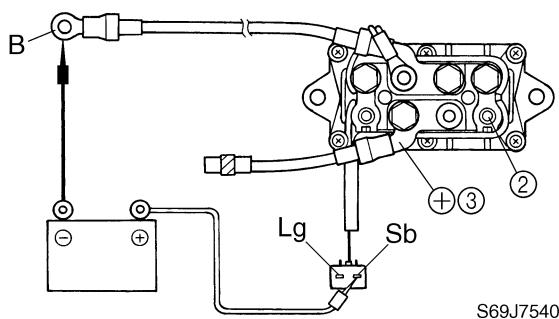
Be sure to set the measurement range **a** shown in the illustration when checking for continuity.

Power trim and tilt relay continuity	
Sky blue (Sb) – Black (B) Light green (Lg) – Black (B)	Continuity
Terminal ① – Terminal ④ Terminal ② – Terminal ④	Continuity
Terminal ① – Terminal ③ Terminal ② – Terminal ③	No continuity

2. Connect the digital circuit tester between power trim and tilt relay terminals ① and ③.
3. Connect the light green (Lg) lead to the positive battery terminal and the black (B) lead to the negative battery terminal as shown.
4. Check for continuity between terminals ① and ③. Replace if there is no continuity.



5. Connect the digital circuit tester between power trim and tilt relay terminals ② and ③.
6. Connect the sky blue (Sb) lead to the positive battery terminal and the black (B) lead to the negative battery terminal as shown.
7. Check for continuity between terminals ② and ③. Replace if there is no continuity.

**BRKT****Bracket unit****NOTE:**

Turn the lever ① and measure the resistance as it gradually changes.



Trim sensor resistance:

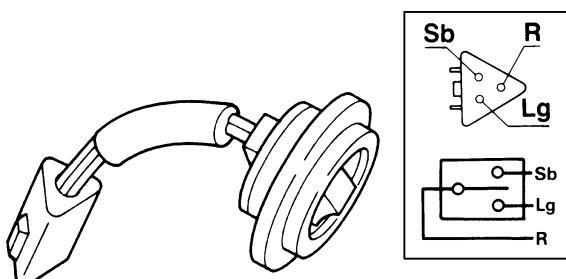
Pink (P) – Black (B)

9–11 Ω at 20 °C (68 °F) ①

247.6–387.6 Ω at 20 °C (68 °F) ②

**Checking the power trim and tilt switch**

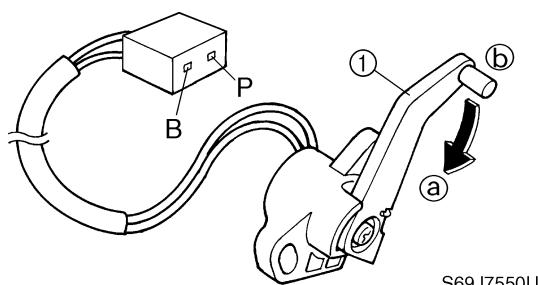
1. Check the power trim and tilt switch for continuity. Replace if out of specification.

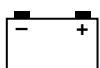


	Lead color		
Switch position	Sky blue (Sb)	Red (R)	Light green (Lg)
Up	○	○	
Free			
Down		○	○

**Checking the trim sensor**

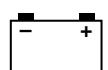
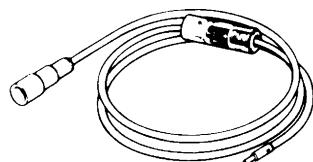
1. Measure the trim sensor resistance. Replace if out of specification.



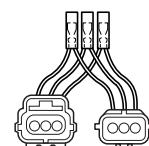


## Electrical systems

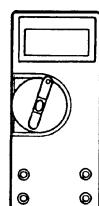
<b>Special service tools .....</b>	<b>8-1</b>
<b>Checking the electrical components.....</b>	<b>8-2</b>
Measuring the peak voltage .....	8-2
Measuring the lower resistance.....	8-2
<b>Electrical components.....</b>	<b>8-3</b>
Starboard and rear views .....	8-3
Port view.....	8-4
Front view .....	8-5
Top view .....	8-6
<b>Wiring harness .....</b>	<b>8-7</b>
<b>Ignition and ignition control system .....</b>	<b>8-10</b>
Checking the ignition spark gap .....	8-11
Checking the ignition coil.....	8-11
Checking the ECM.....	8-12
Checking the pulser coil .....	8-12
Checking the throttle position sensor .....	8-12
Checking the intake air temperature sensor.....	8-13
Checking the engine temperature sensor.....	8-13
Checking the thermoswitch .....	8-14
Checking the shift cut switch .....	8-14
Checking the neutral switch.....	8-14
Checking the main relay .....	8-15
<b>Fuel control system .....</b>	<b>8-16</b>
Checking the low-pressure fuel pump and high-pressure fuel pump .....	8-18
<b>Starting system .....</b>	<b>8-19</b>
Checking the fuse.....	8-20
Checking the wiring harness (10 pins) .....	8-20
Checking the starter relay.....	8-20
<b>Starter motor .....</b>	<b>8-21</b>
Removing the starter motor pinion .....	8-23
Checking the starter motor pinion.....	8-23
Checking the armature .....	8-23
Checking the brushes .....	8-24
Checking the magnet switch.....	8-24
Checking the starter motor operation .....	8-24
<b>Charging system .....</b>	<b>8-25</b>
Checking the stator coil .....	8-26
Checking the Rectifier Regulator.....	8-26

**Special service tools**

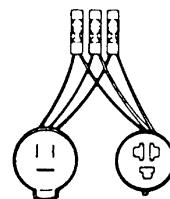
**Dynamic spark tester**  
YM-34487



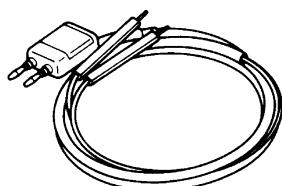
**Test harness (3 pins)**  
YB-06793



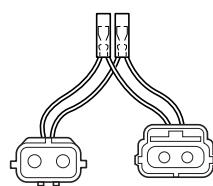
**Digital multimeter**  
YU-34899-A



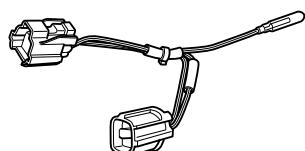
**Test harness (3 pins)**  
YB-06770



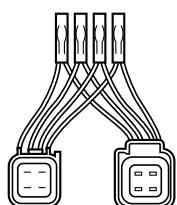
**Peak voltage adaptor**  
YU-39991



**Test harness (2 pins)**  
YB-06787



**Test harness (2 pins)**  
YB-06792



**Test harness (4 pins)**  
YB-06771

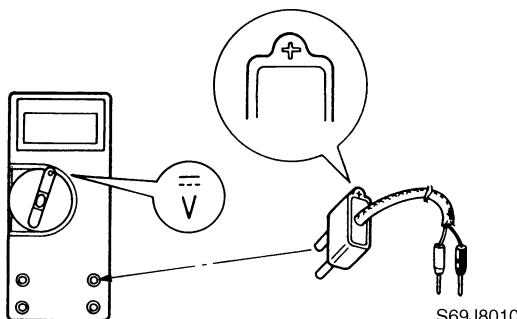
## Special service tools / Checking the electrical components

### Checking the electrical components

#### Measuring the peak voltage

**NOTE:** \_\_\_\_\_  
Before troubleshooting the peak voltage, check that all electrical connections are tight and free from corrosion, and that the battery is fully charged to 12 V.

The condition of the ignition system can be determined by measuring the peak voltage. Cranking speed is effected by many factors, such as fouled or weak spark plugs, or a weak battery. If one of these factors is present, the peak voltage will be lower than specification. In addition, if the peak voltage is lower than specification the engine will not operate properly.



#### **WARNING**

When checking the peak voltage, do not touch any of the connections of the digital tester leads.

**NOTE:** \_\_\_\_\_

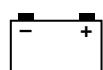
- Use the peak voltage adaptor with the digital circuit tester.
- When measuring the peak voltage, set the selector on the digital circuit tester to the **DC voltage mode**.
- Connect the positive pin on the peak voltage adaptor to the positive terminal of the digital circuit tester.

### Measuring the lower resistance

When measuring a resistance of  $10 \Omega$  or less with the digital circuit tester, the correct measurement cannot be obtained because of the internal resistance of the tester. To obtain the correct value, subtract the internal resistance from the displayed measurement.

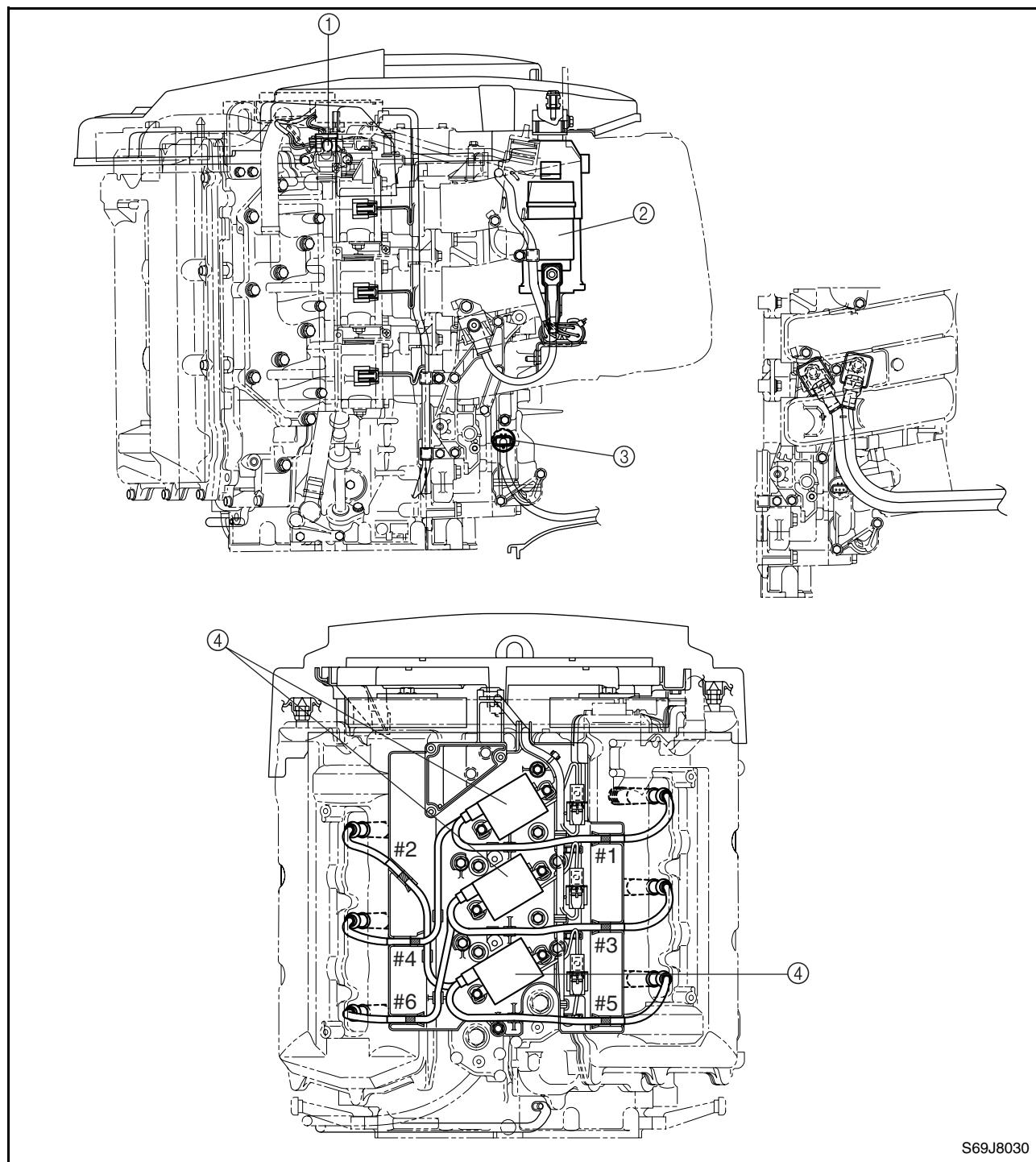
**NOTE:** \_\_\_\_\_  
Obtain the internal resistance of the digital circuit tester by connecting both of its probes and checking the display.

Correct value =  
displayed measurement – internal  
resistance



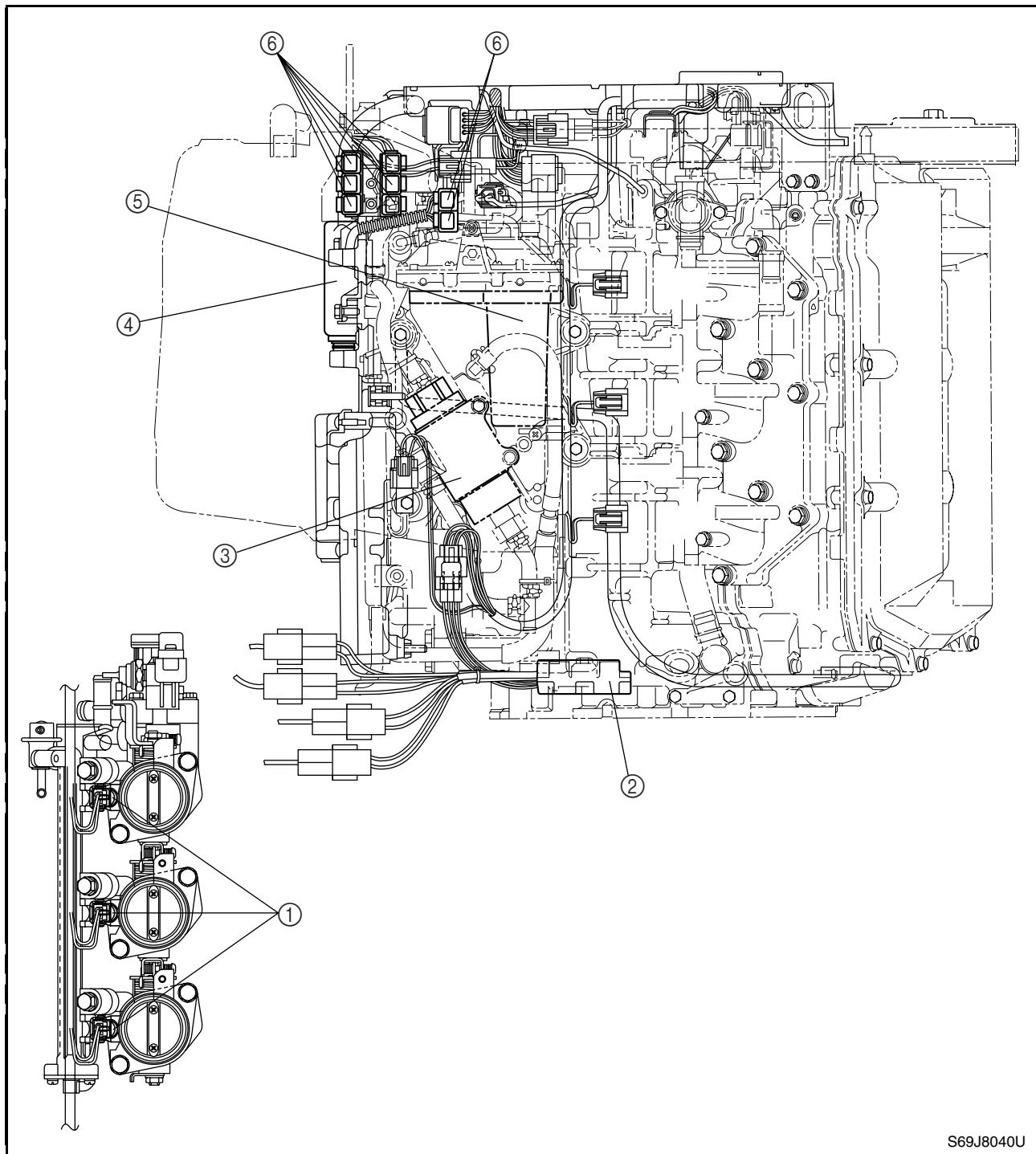
## Electrical components

### Starboard and rear views



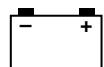
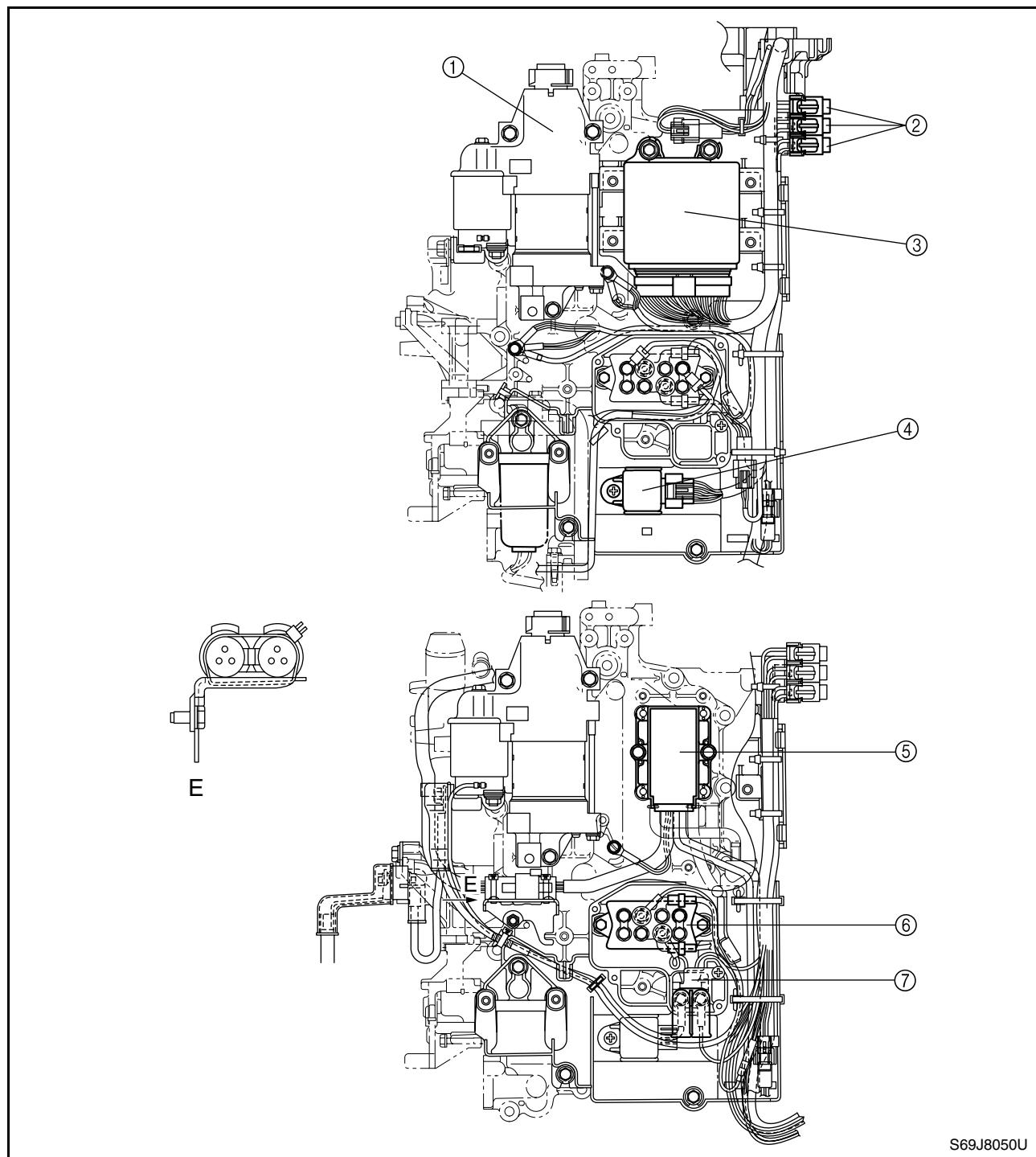
- ① Thermoswitch
- ② Starter motor
- ③ Oil pressure sensor
- ④ Ignition coils

### Port view



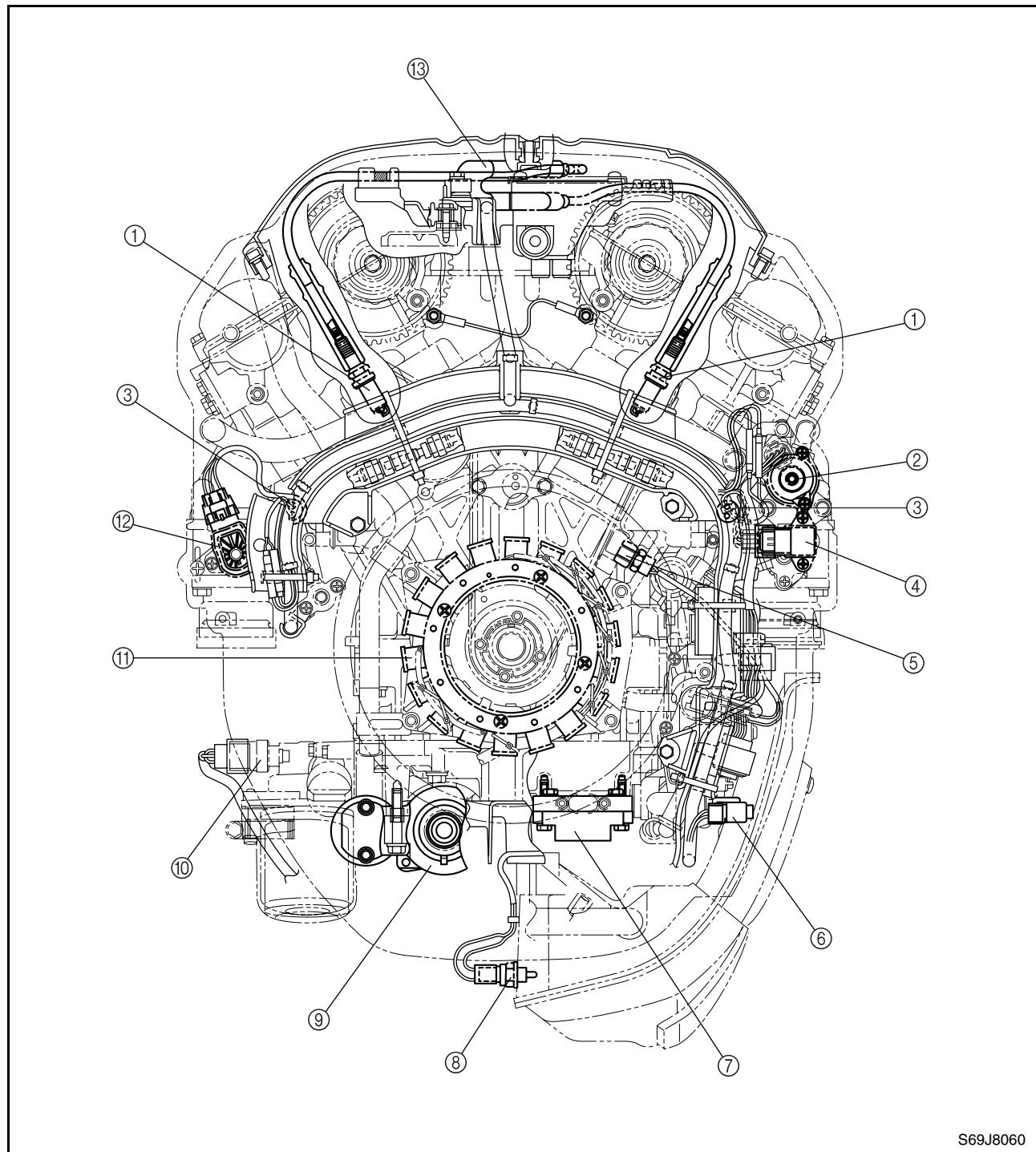
- ① Fuel injectors
- ② Fuel pump driver and isolator
- ③ Low-pressure fuel pump
- ④ ECM
- ⑤ High-pressure fuel pump
- ⑥ Fuses

S69J8040U

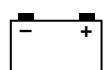
**Front view**

- ① Starter motor
- ② Fuses
- ③ ECM
- ④ Main relay
- ⑤ Rectifier Regulator
- ⑥ Power trim and tilt relay
- ⑦ Starter relay

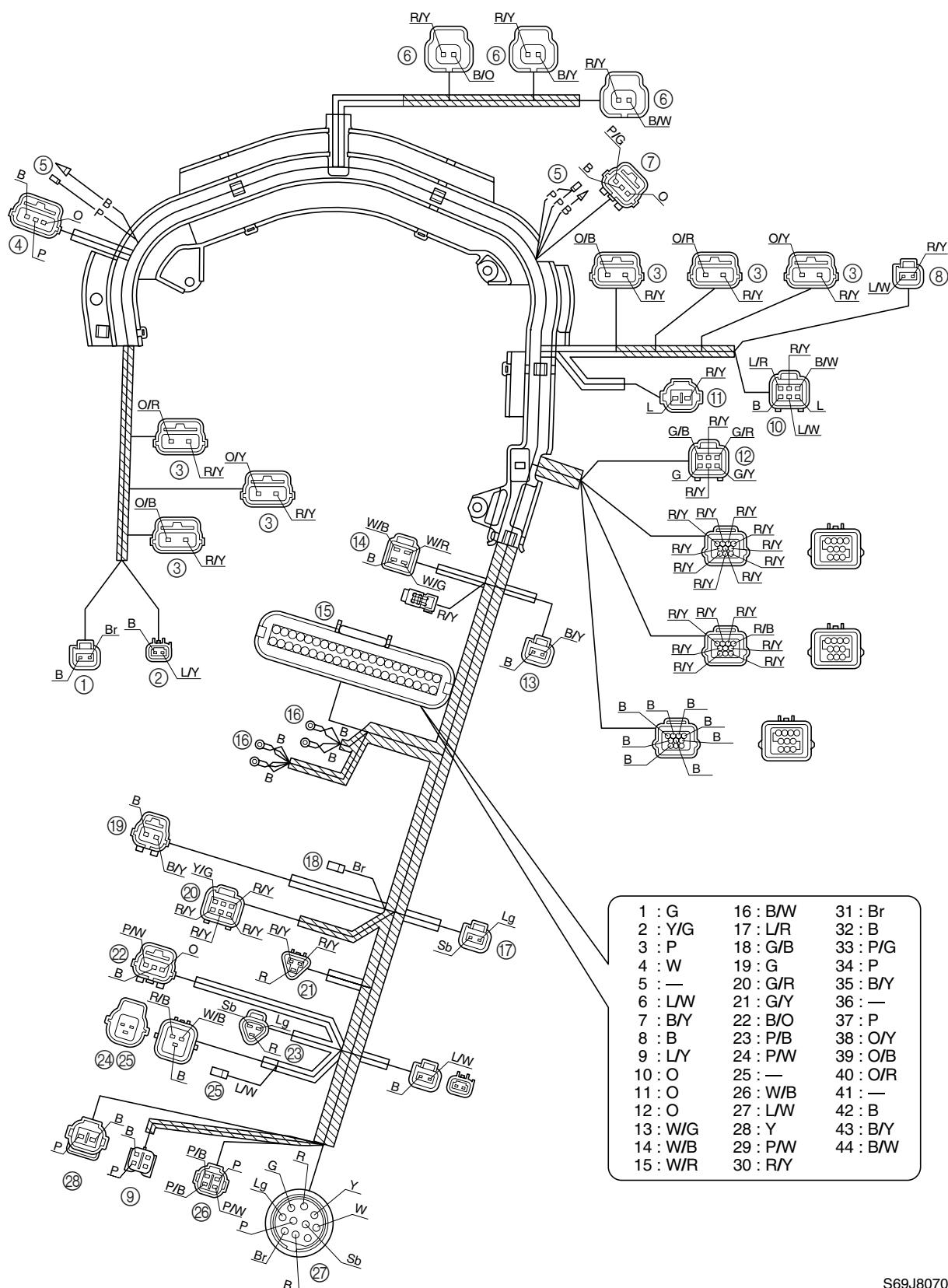
### Top view



- |                                 |                            |
|---------------------------------|----------------------------|
| ① Spark plugs                   | ⑪ Stator coil              |
| ② Idle speed control            | ⑫ Throttle position sensor |
| ③ Thermoswitches                | ⑬ Ignition coils           |
| ④ Intake air pressure sensor    |                            |
| ⑤ Engine temperature sensor     |                            |
| ⑥ Fuses                         |                            |
| ⑦ Rectifier Regulator           |                            |
| ⑧ Intake air temperature sensor |                            |
| ⑨ Starter motor                 |                            |
| ⑩ Oil pressure sensor           |                            |

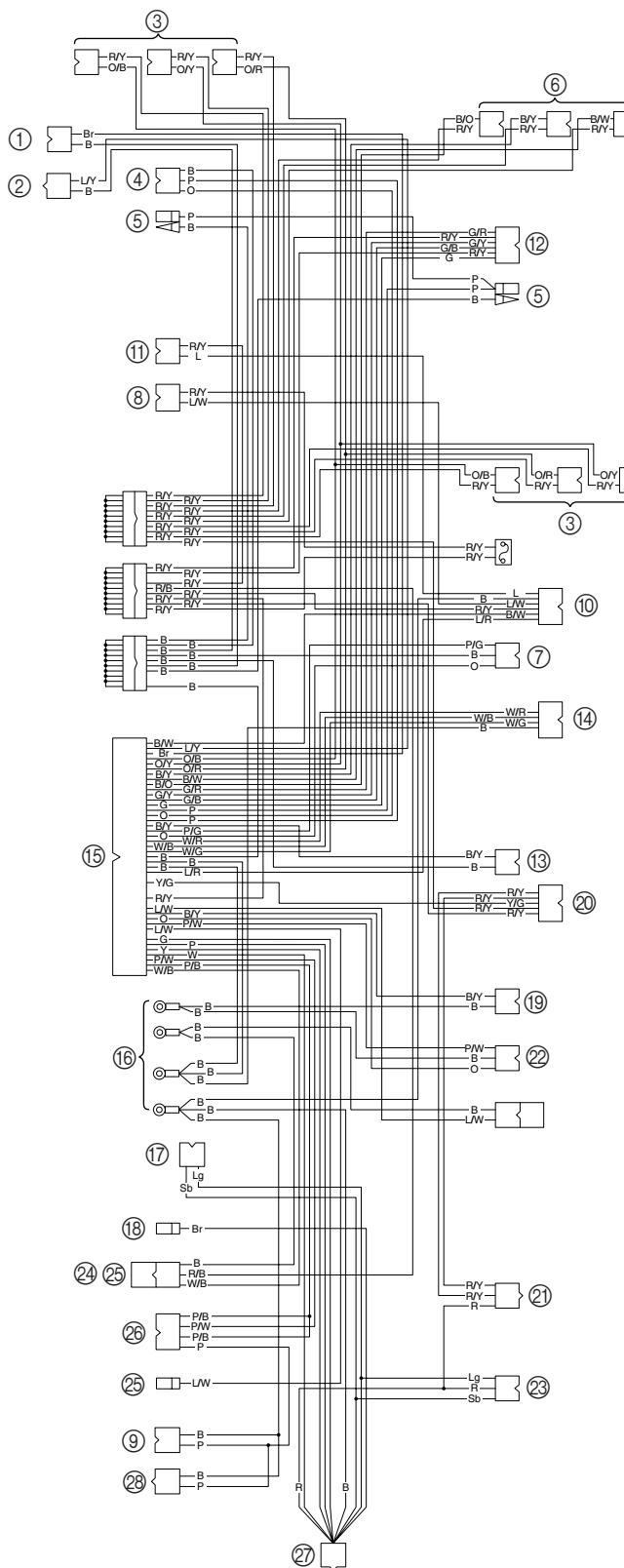


## Wiring harness



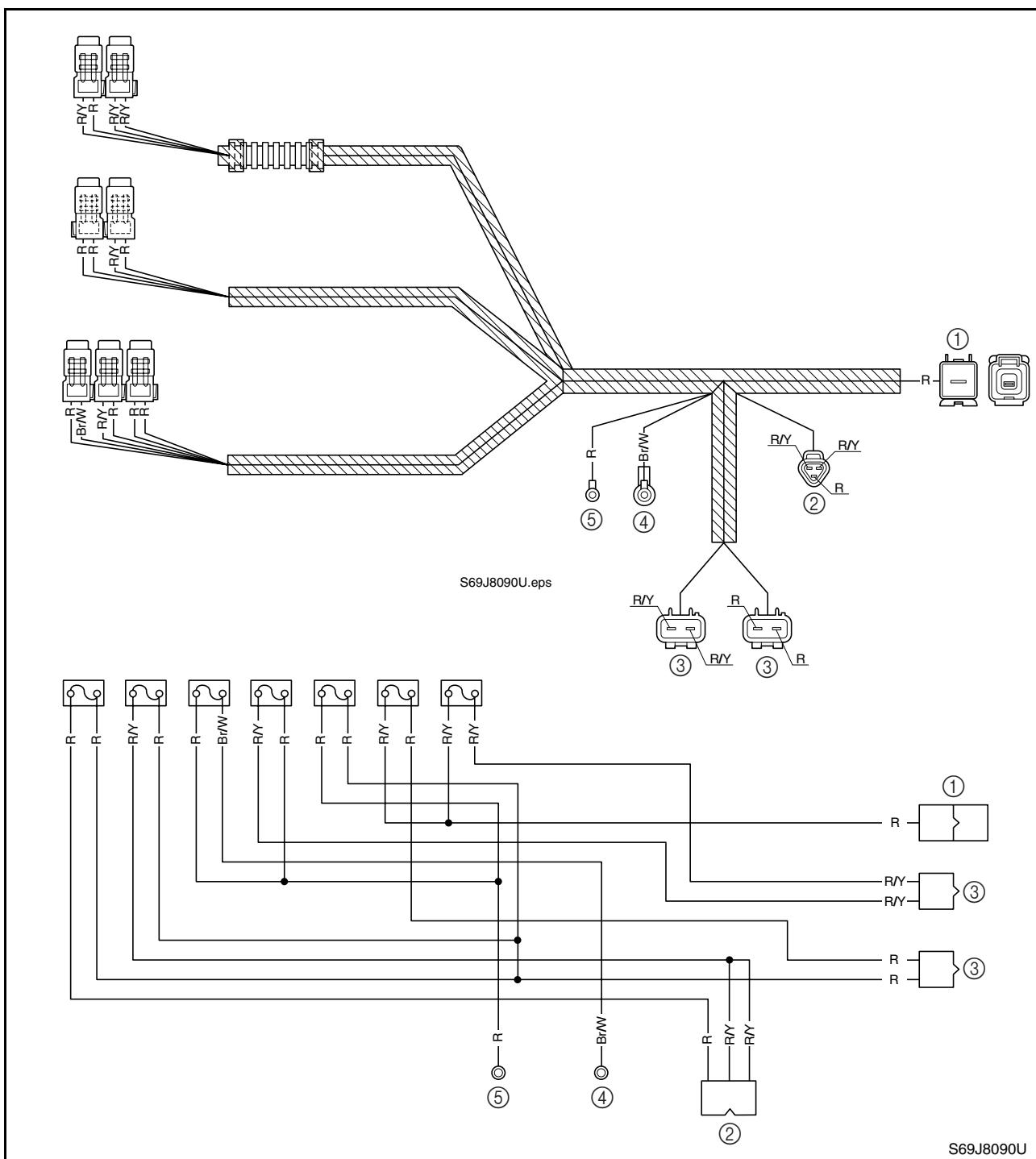
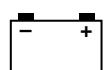
S69J8070U

## Wiring harness



### Connect to:

- ① Neutral switch
- ② Shift cut switch
- ③ Fuel injector
- ④ Throttle position sensor
- ⑤ Thermoswitch
- ⑥ Ignition coil
- ⑦ Intake air pressure sensor
- ⑧ Low-pressure fuel pump
- ⑨ Trim meter
- ⑩ Fuel pump driver and isolator
- ⑪ High-pressure fuel pump
- ⑫ Idle speed control
- ⑬ Engine temperature sensor
- ⑭ Pulser coil
- ⑮ ECM
- ⑯ Ground
- ⑰ Power trim and tilt relay
- ⑱ Starter relay
- ⑲ Intake air temperature sensor
- ⑳ Main relay
- ㉑ Fuse (20 A)
- ㉒ Oil pressure sensor
- ㉓ Power trim and tilt switch
- ㉔ Computer
- ㉕ Diagnostic indicator
- ㉖ Warning indicator
- ㉗ Remote control
- ㉘ Trim sensor



Connect to:

- ① Accessory battery
- ② Main relay
- ③ Fuel pump driver and isolator
- ④ Starter relay
- ⑤ Power trim and tilt relay

B : Black  
Br : Brown

G : Green  
Gy : Gray  
L : Blue  
Lg : Light green  
O : Orange  
P : Pink

R : Red  
Sb : Sky blue  
W : White  
Y : Yellow  
B/O : Black/orange

B/W : Black/white  
B/Y : Black/yellow  
Br/W : Brown/white

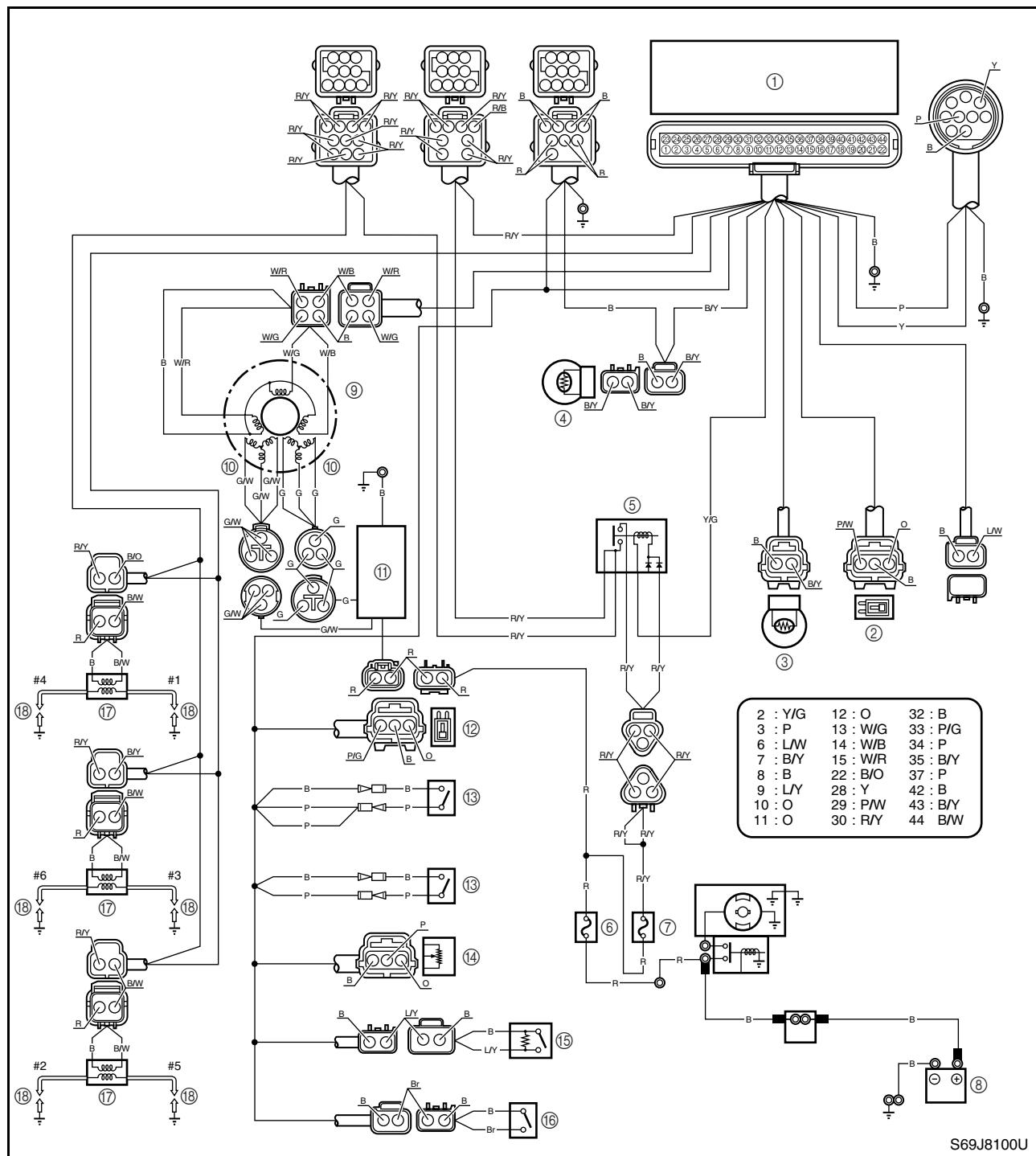
G/B : Green/black  
G/R : Green/red  
G/W : Green/white  
G/Y : Green/yellow  
L/R : Blue/red  
L/W : Blue/white  
L/Y : Blue/yellow  
O/B : Orange/black

O/R : Orange/red  
O/Y : Orange/yellow

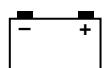
P/B : Pink/black  
P/G : Pink/green  
P/W : Pink/white  
R/B : Red/black  
R/Y : Red/yellow  
W/B : White/black  
W/G : White/green  
W/R : White/red  
Y/G : Yellow/green

# Wiring harness / Ignition and ignition control system

## Ignition and ignition control system

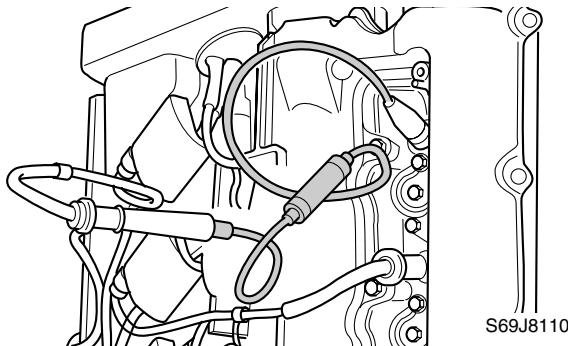


- (1) ECM  
 (2) Oil pressure sensor  
 (3) Intake air temperature sensor  
 (4) Engine temperature sensor  
 (5) Main relay  
 (6) Fuse (30 A)  
 (7) Fuse (20 A)  
 (8) Battery  
 (9) Pulser coil  
 (10) Stator coil  
 (11) Rectifier Regulator  
 (12) Intake air pressure sensor  
 (13) Thermoswitch  
 (14) Throttle position sensor  
 (15) Shift cut switch  
 (16) Neutral switch  
 (17) Ignition coil  
 (18) Spark plug
- B/W : Black/white  
 B/Y : Black/yellow  
 L/Y : Blue/yellow  
 P/G : Pink/green  
 P/W : Pink/white  
 R/Y : Red/yellow  
 W/B : White/black  
 W/G : White/green  
 W/R : White/red  
 Y/G : Yellow/green



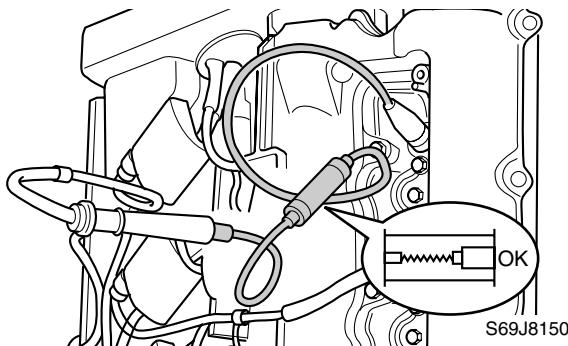
### Checking the ignition spark gap

1. Remove the ignition coil cover and disconnect the spark plug caps from the spark plugs.
2. Connect a spark plug cap to the special service tool.



Dynamic spark tester: YM-34487

3. Crank the engine and observe the spark through the discharge window of the spark gap tester. Check the ignition system if the spark is weak.

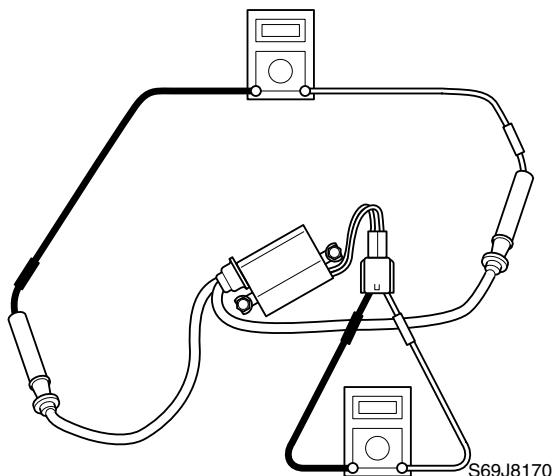


#### **⚠ WARNING**

- Do not touch any of the connections of the spark gap tester leads.
- Do not let sparks leak out of the removed spark plug caps.
- Keep flammable gas or liquids away, since this test can produce sparks.

### Checking the ignition coil

1. Remove the spark plug wires from the spark plugs.
2. Disconnect the ignition coil coupler.
3. Measure the ignition coil resistance. Replace if out of specification.



Ignition coil resistance:

Primary coil:

Red/yellow (R/Y) –

Black/orange (B/O)

Red/yellow (R/Y) –

Black/yellow (B/Y)

Red/yellow (R/Y) –

Black/white (B/W)

1.5–1.9  $\Omega$  at 20 °C (68 °F)

Secondary coil:

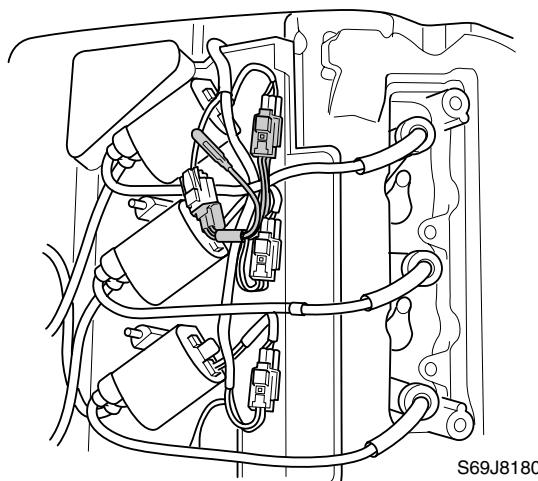
Spark plug wire – Spark plug wire

19.6–35.4 k $\Omega$  at 20 °C (68 °F)

## Ignition and ignition control system

### Checking the ECM

1. Remove the ignition coil cover and disconnect the ignition coil coupler.
2. Connect the test harness (2 pins) to the ignition coil.
3. Measure the ECM output peak voltage. If below specification, measure the pulser coil output peak voltage. Replace the ECM if the output peak voltage of the pulser coil is above specification.



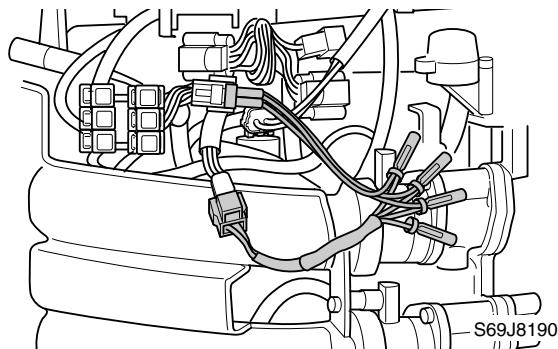
	Digital multimeter: YU-34899-A Peak voltage adaptor: YU-39991 Test harness (2 pins): YB-06792
--	---

	ECM output peak voltage:		
	Black/orange (B/O) – Ground	Black/yellow (B/Y) – Ground	Black/white (B/W) – Ground
r/min			Loaded
Cranking	1,500	3,500	DC V
252	260	260	

### Checking the pulser coil

1. Remove the flywheel magnet cover and disconnect the pulser coil coupler.
2. Connect the test harness (4 pins) to the pulser coil.
4. Measure the throttle position sensor output voltage. Adjust the throttle position sensor if out of specification.

3. Measure the pulser coil output peak voltage. Replace the pulser coil if below specification.



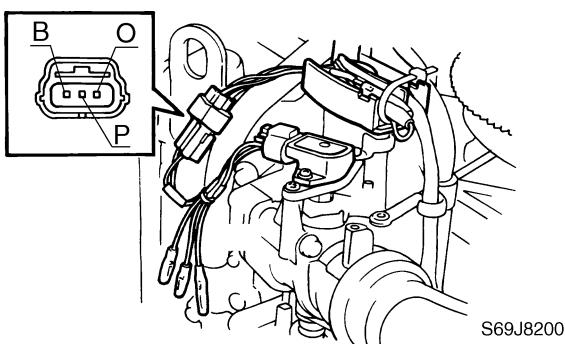
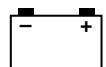
	Digital multimeter: YU-34899-A Peak voltage adaptor: YU-39991 Test harness (4 pins): YB-06771
--	---

	Pulser coil output peak voltage: White/red (W/R) – Black (B) White/black (W/B) – Black (B) White/green (W/G) – Black (B)		
r/min		Unloaded	Loaded
Cranking	1,500	20	43
DC V	5.3	5.3	3,500

	Pulser coil resistance (use as reference): White/red (W/R) – Black (B) White/black (W/B) – Black (B) White/green (W/G) – Black (B) 459–561 Ω at 20 °C (68 °F)
--	---

### Checking the throttle position sensor

1. Connect the test harness (3 pins) to the throttle position sensor.
2. Turn the engine start switch to ON.
3. Measure the throttle position sensor input voltage. Replace the ECM if out of specification.



Test harness (3 pins): YB-06793

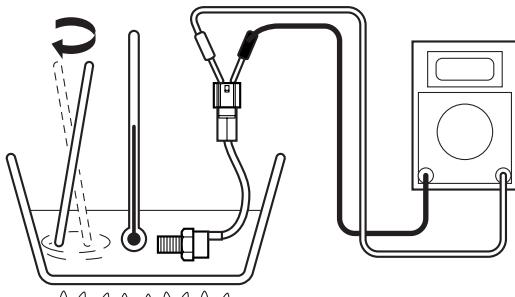


Throttle position sensor input voltage:  
Orange (O) – Black (B)  
5 V

Throttle position sensor output voltage:  
Pink (P) – Black (B)  
695–705 mV

### Checking the engine temperature sensor

1. Place the engine temperature sensor in a container of water and slowly heat the water.



2. Measure the engine temperature sensor resistance. Replace if out of specification.

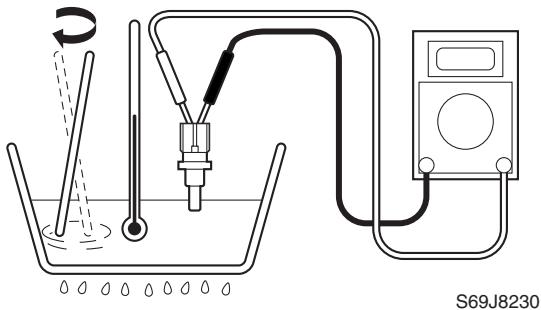


Engine temperature sensor resistance:

Black/yellow (B/Y) – Black (B)  
at 20 °C (68 °F): 54.2–69.0 kΩ  
at 100 °C (212 °F): 3.12–3.48 kΩ

### Checking the intake air temperature sensor

1. Place the intake air temperature sensor in a container of water and slowly heat the water.



2. Measure the intake air temperature sensor resistance. Replace if out of specification.



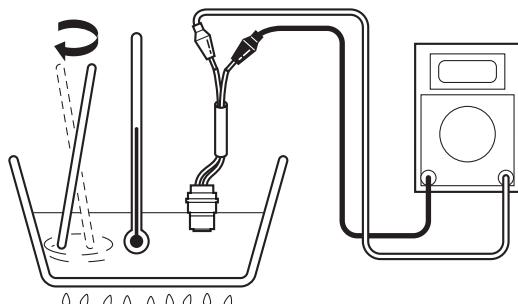
Intake air temperature sensor resistance:

at 0 °C (32 °F): 5.4–6.6 kΩ  
at 80 °C (176 °F): 0.29–0.39 kΩ

## Ignition and ignition control system

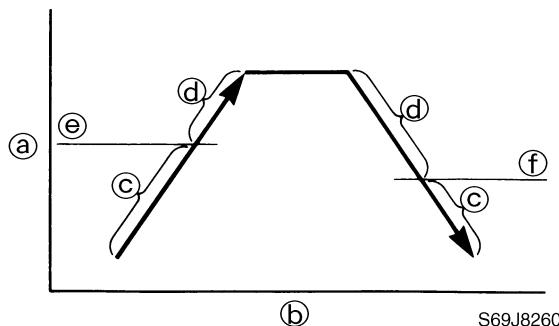
### Checking the thermoswitch

1. Place the thermoswitch in a container of water and slowly heat the water.



S69J8250

2. Check the switch for continuity at the specified temperatures. Replace if out of specification.



(b)

S69J8260

- ① Temperature
- ② Time
- ③ No continuity
- ④ Continuity



Thermoswitch continuity temperature:

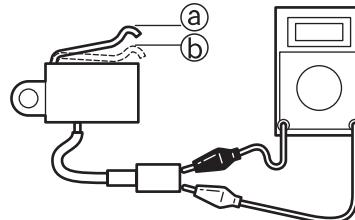
Pink (P) – Black (B)

④: 84–90 °C (183–194 °F)

⑤: 68–82 °C (154–179 °F)

### Checking the shift cut switch

1. Check the shift cut switch for continuity. Replace if there is no continuity.

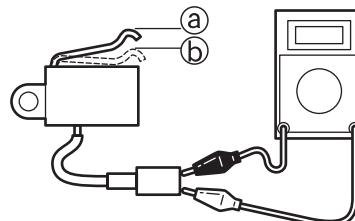


S69J8270

Switch position	Lead color	
	Blue/yellow (L/Y)	Black (B)
Free ①		
Push ②	○	○

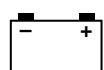
### Checking the neutral switch

1. Check the neutral switch for continuity. Replace if there is no continuity.



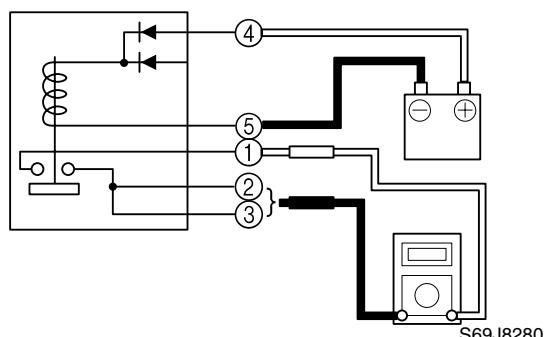
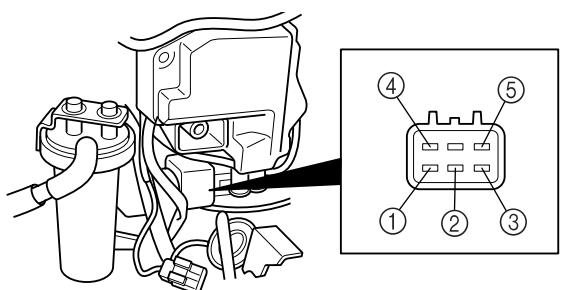
S69J8270

Switch position	Lead color	
	Brown (Br)	Black (B)
Free ①		
Push ②	○	○



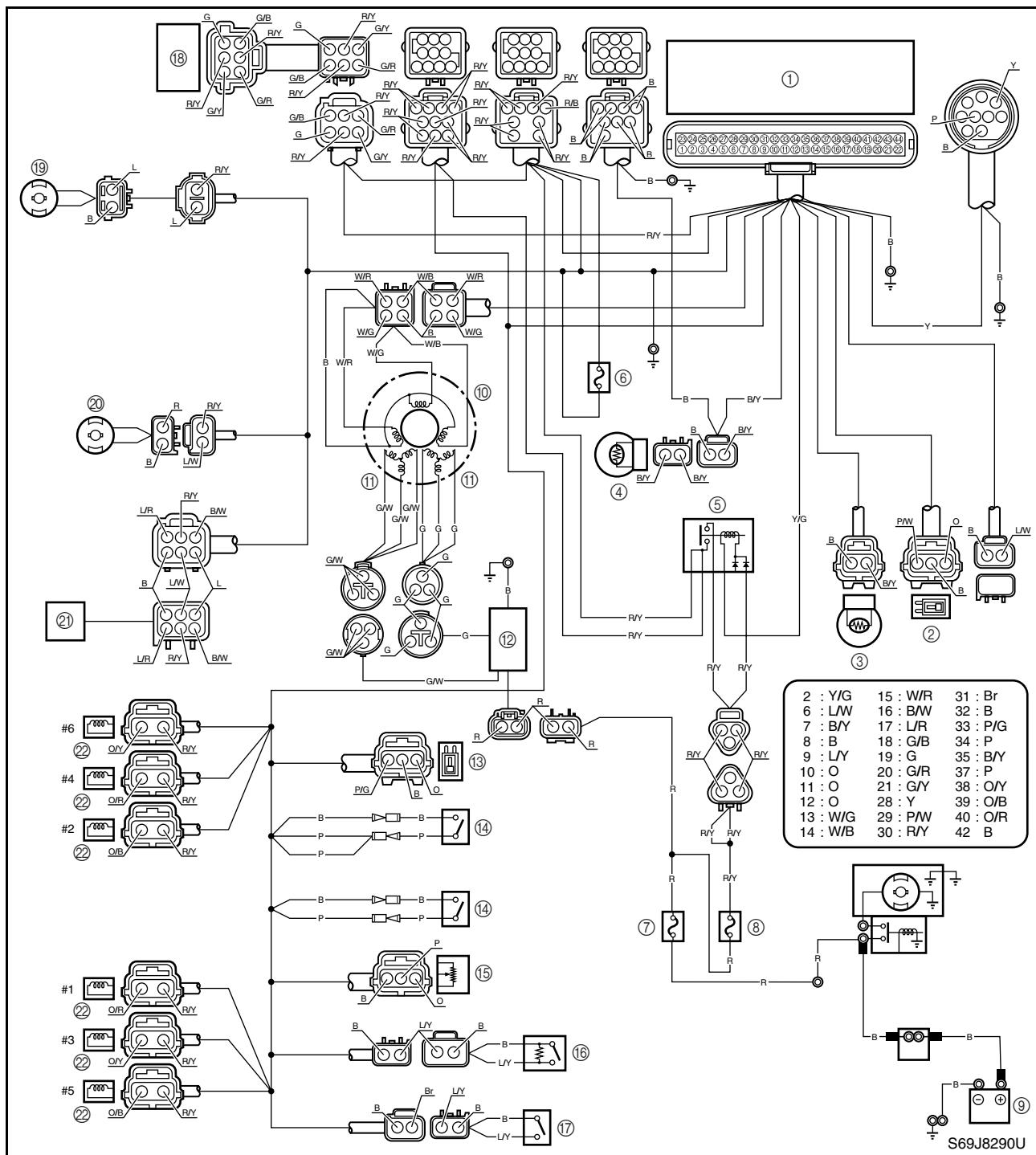
### Checking the main relay

1. Connect the digital circuit tester leads to main relay terminals ①, ②, and ③.
2. Connect the terminal ④ to the positive battery terminal.
3. Connect the terminal ⑤ to the negative battery terminal.
4. Check for continuity between the main relay terminals. Replace if there is no continuity.
5. Check that there is no continuity between the main relay terminals after disconnecting terminal ④ or ⑤. Replace if there is continuity.

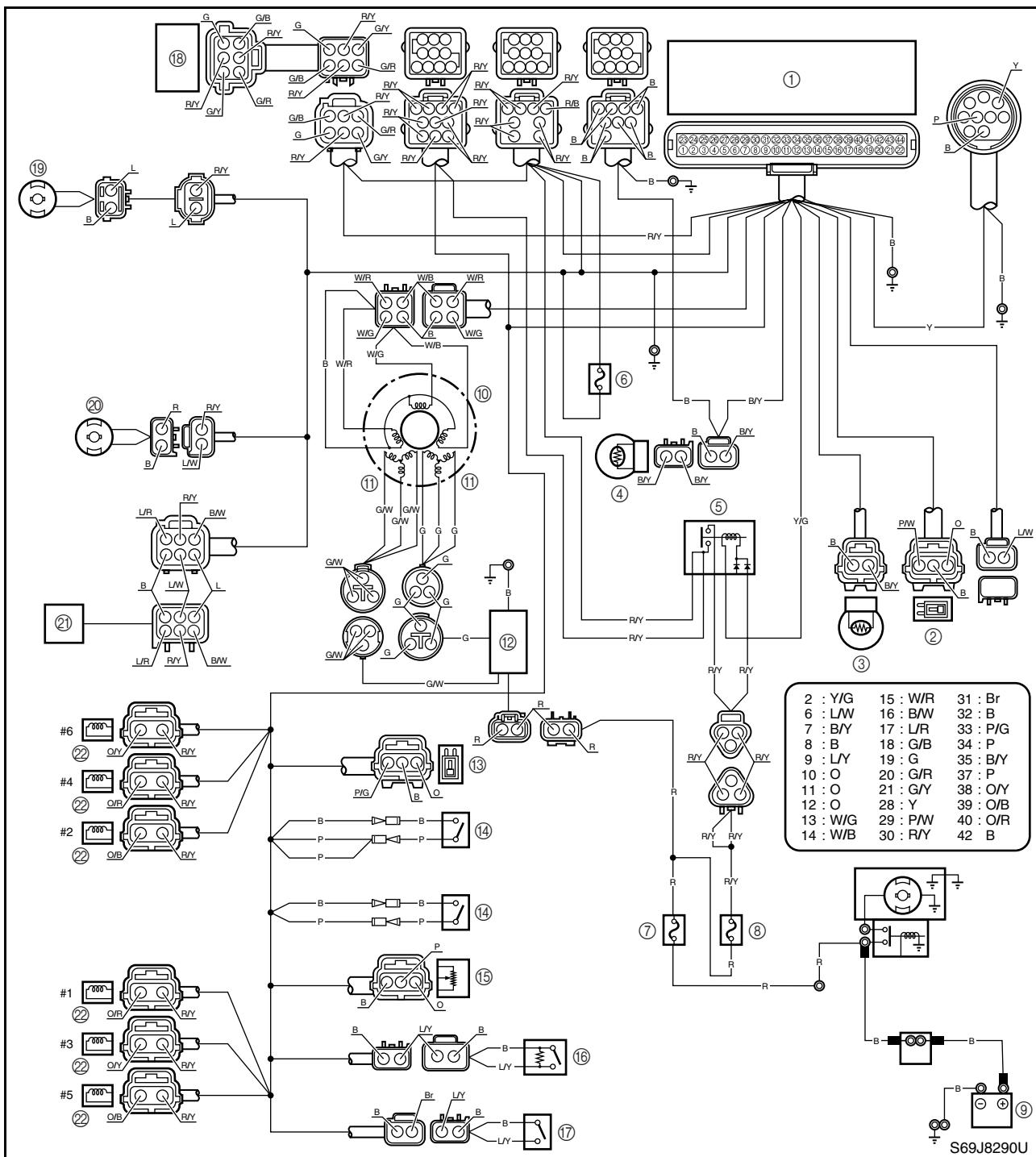
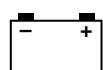


# Ignition and ignition control system / Fuel control system

## Fuel control system



- ① ECM
- ② Oil pressure sensor
- ③ Intake air temperature sensor
- ④ Engine temperature sensor
- ⑤ Main relay
- ⑥ Fuse (5 A)
- ⑦ Fuse (30 A)
- ⑧ Fuse (20 A)
- ⑨ Battery
- ⑩ Pulser coil
- ⑪ Stator coil
- ⑫ Rectifier Regulator
- ⑬ Intake air pressure sensor
- ⑭ Thermoswitch
- ⑮ Throttle position sensor
- ⑯ Shift cut switch
- ⑰ Neutral switch
- ⑱ Idle speed control
- ⑲ High-pressure fuel pump
- ⑳ Low-pressure fuel pump
- ㉑ Fuel pump driver and isolator
- ㉒ Fuel injector



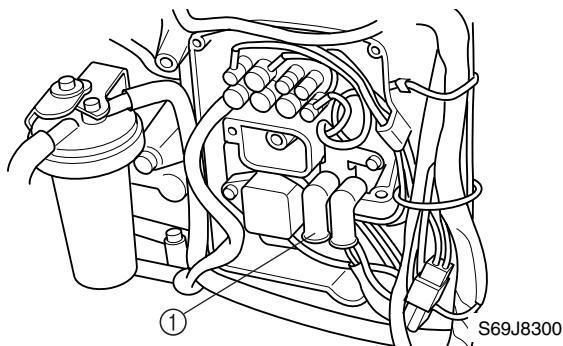
B : Black  
 Br : Brown  
 G : Green  
 L : Blue  
 O : Orange  
 P : Pink  
 R : Red  
 Y : Yellow  
 B/W : Black/white  
 B/Y : Black/yellow

G/B : Green/black  
 G/R : Green/red  
 G/W : Green/white  
 G/Y : Green/yellow  
 L/R : Blue/red  
 L/Y : Blue/yellow  
 O/B : Orange/black  
 O/R : Orange/red  
 O/Y : Orange/yellow  
 P/G : Pink/green

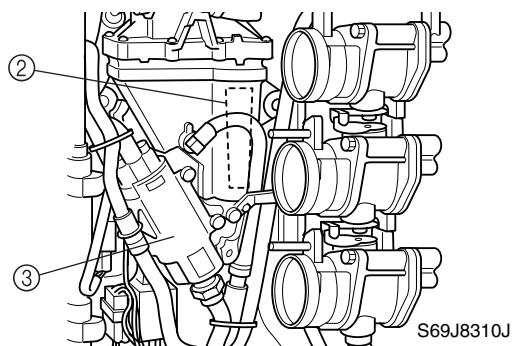
P/W : Pink/white  
 R/Y : Red/yellow  
 W/B : White/black  
 W/G : White/green  
 W/R : White/red  
 Y/G : Yellow/green

### Checking the low-pressure fuel pump and high-pressure fuel pump

1. Disconnect the starter relay lead (brown lead) ① to prevent the engine from starting.



2. Turn the engine start switch to ON.
3. Listen for the operating sound of the high-pressure fuel pump ②. Replace if there is no sound.

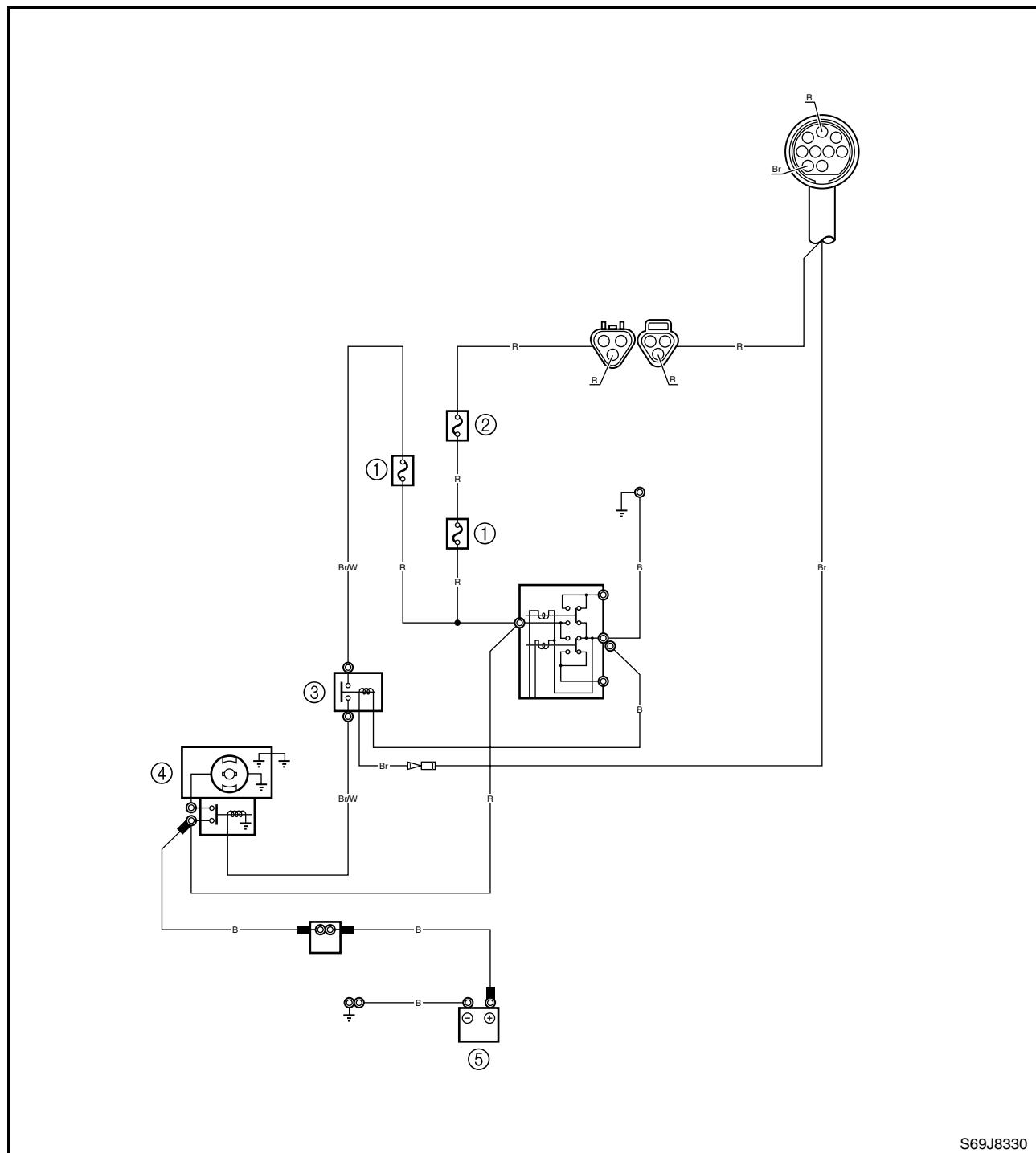


**NOTE:**

- After the engine start switch is turned to ON, the high-pressure fuel pump will operate for 5 seconds.
- Check the operation of the low-pressure fuel pump ③ using the “Stationary test” of the Yamaha Diagnostic System.



## Starting system



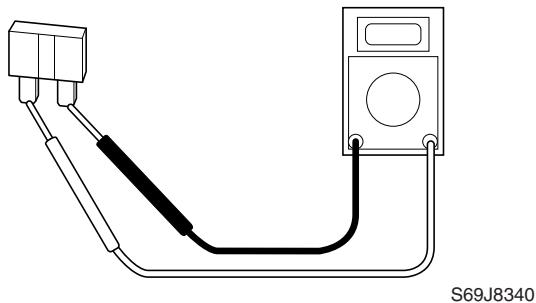
S69J8330

- ① Fuse (30 A)
- ② Fuse (20 A)
- ③ Starter relay
- ④ Starter motor
- ⑤ Battery

B	: Black
Br	: Brown
R	: Red
Br/W	: Brown/white

### Checking the fuse

1. Check the fuse for continuity. Replace if there is no continuity.



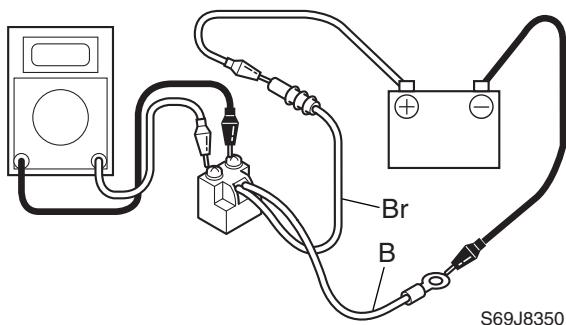
### Checking the wiring harness

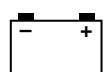
#### (10 pins)

1. Check the wiring harness for continuity. Replace if there is no continuity.

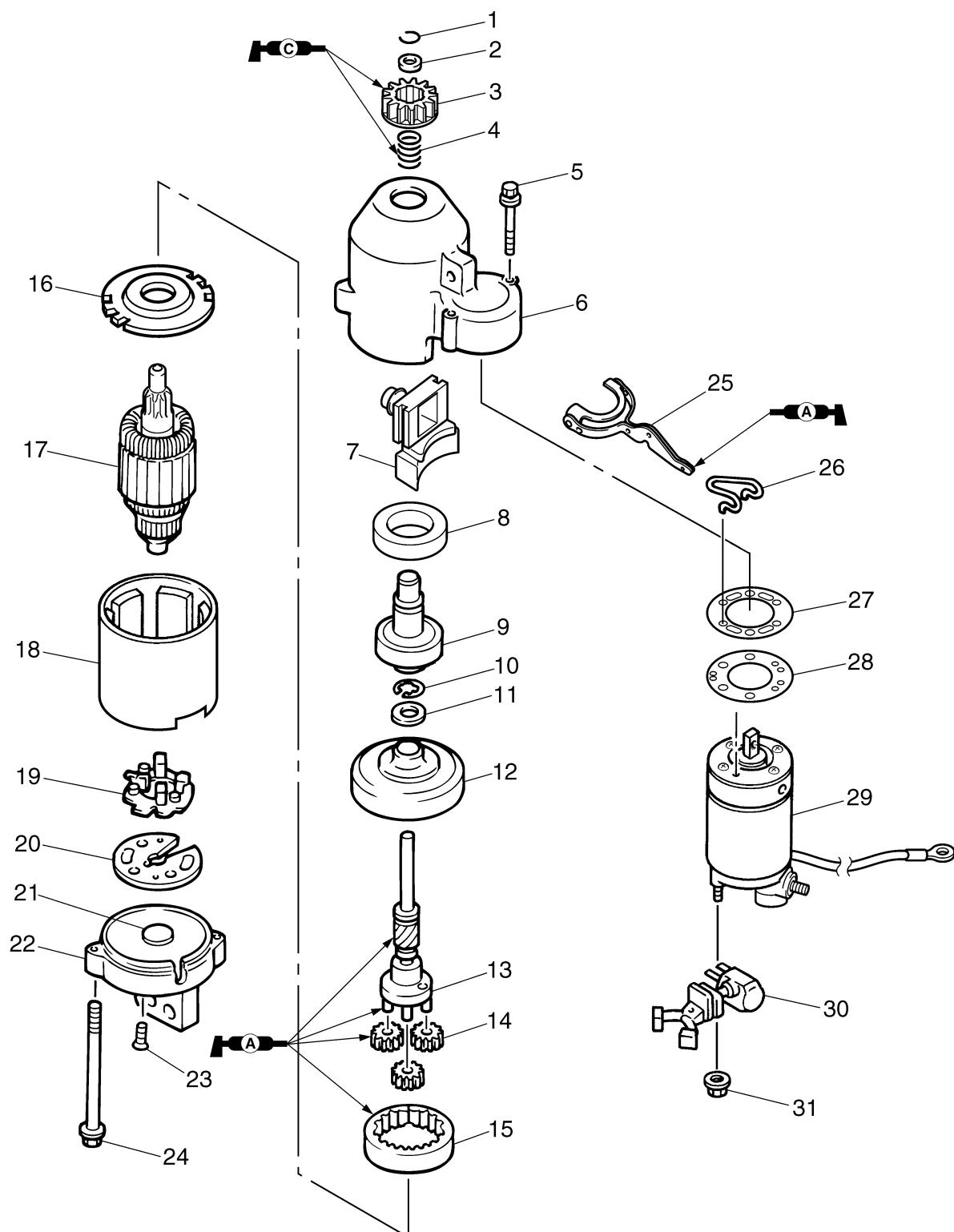
### Checking the starter relay

1. Connect the digital circuit tester leads to the starter relay terminals.
2. Connect the brown (Br) lead to the positive battery terminal.
3. Connect the black (B) lead to the negative battery terminal.
4. Check for continuity between the starter relay terminals. Replace if there is no continuity.
5. Check that there is no continuity between the starter relay terminals after disconnecting the brown or black lead. Replace if there is continuity.





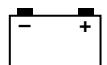
## Starter motor



S69J8360

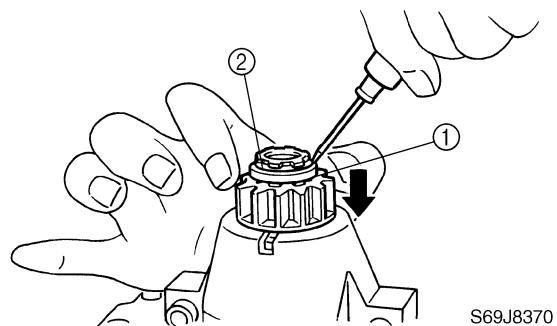
## Starter motor

No.	Part name	Q'ty	Remarks
1	Clip	1	
2	Pinion stopper	1	
3	Starter motor pinion	1	
4	Spring	1	
5	Bolt	2	M6 × 35 mm
6	Housing	1	
7	Rubber seal	1	
8	Bearing	1	
9	Clutch assembly	1	
10	E-clip	1	<b>Not reusable</b>
11	Thrust washer	1	
12	Center bracket	1	
13	Pinion shaft	1	
14	Planetary gear	3	
15	Outer gear	1	
16	Plate	1	
17	Armature	1	
18	Stator	1	
19	Brush holder assembly	1	
20	Plate	1	
21	Thrust washer	1	
22	Lower bracket	1	
23	Screw	2	M4 × 15 mm
24	Bolt	2	M6 × 120 mm
25	Shift lever	1	
26	Spring	1	
27	Metal gasket	1	
28	Gasket	1	<b>Not reusable</b>
29	Magnet switch	1	
30	Brush assembly	1	
31	Nut	1	

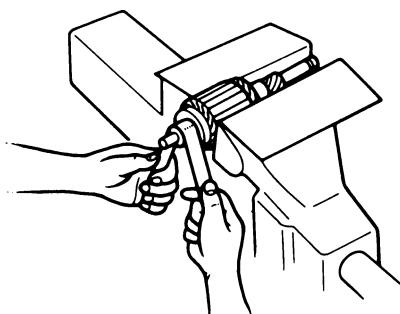


### Removing the starter motor pinion

- Slide the pinion stopper ① down as shown, and then remove the clip ②.



S69J8370



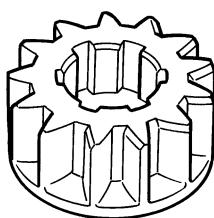
S69J8390

**NOTE:**

Remove the clip with a thin screwdriver.

### Checking the starter motor pinion

- Check the teeth of the pinion for cracks or wear. Replace if necessary.



S69J8380

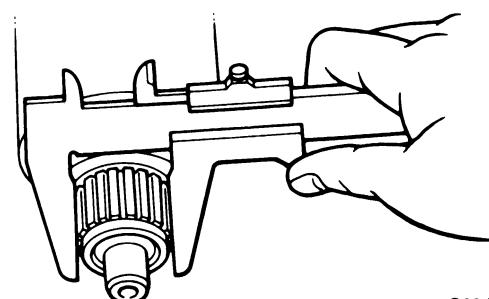
- Check for smooth operation. Replace if necessary.

**NOTE:**

Turn the pinion counterclockwise to check that it operates smoothly and turn it clockwise to check that it locks in place.

### Checking the armature

- Check the commutator for dirt. Clean with #600 grid sandpaper and compressed air if necessary.

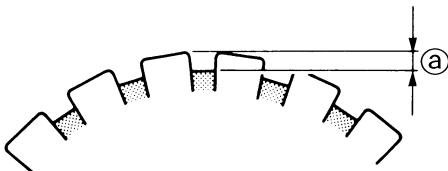


S69J8400



Commutator diameter limit:  
28.0 mm (1.10 in)

- Measure the commutator undercut ④. Replace the armature if out of specification.

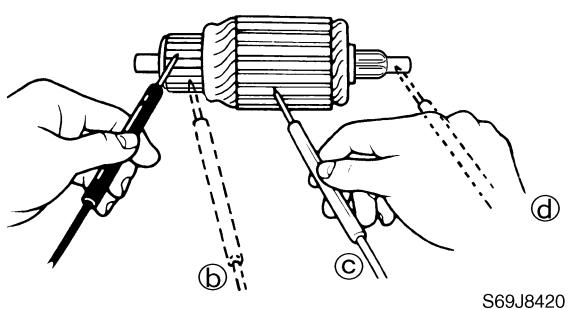


S69J8410



Commutator undercut limit ④:  
0.2 mm (0.01 in)

- Check the armature for continuity. Replace if out of specifications.

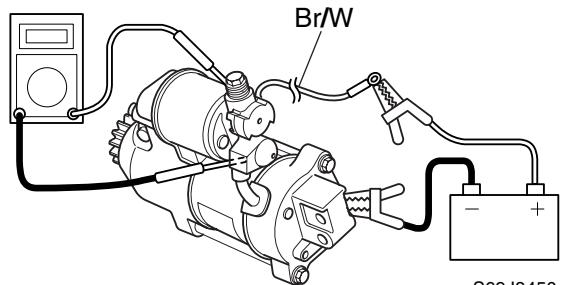


S69J8420

	Brush continuity
Brush ① – Brush ②	No continuity

## Checking the magnet switch

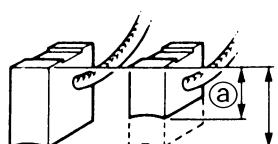
1. Connect the tester leads between the magnet switch terminals as shown.
2. Connect the positive battery terminal to the black and white (B/W) lead.
3. Connect the negative battery terminal to the starter motor body.



S69J8450

## Checking the brushes

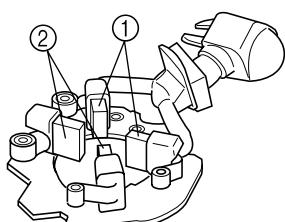
1. Measure the brush length. Replace the brush assembly if out of specification.



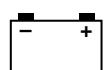
S69J8430

	Brush length limit ④: 9.5 mm (0.37 in)
--	---

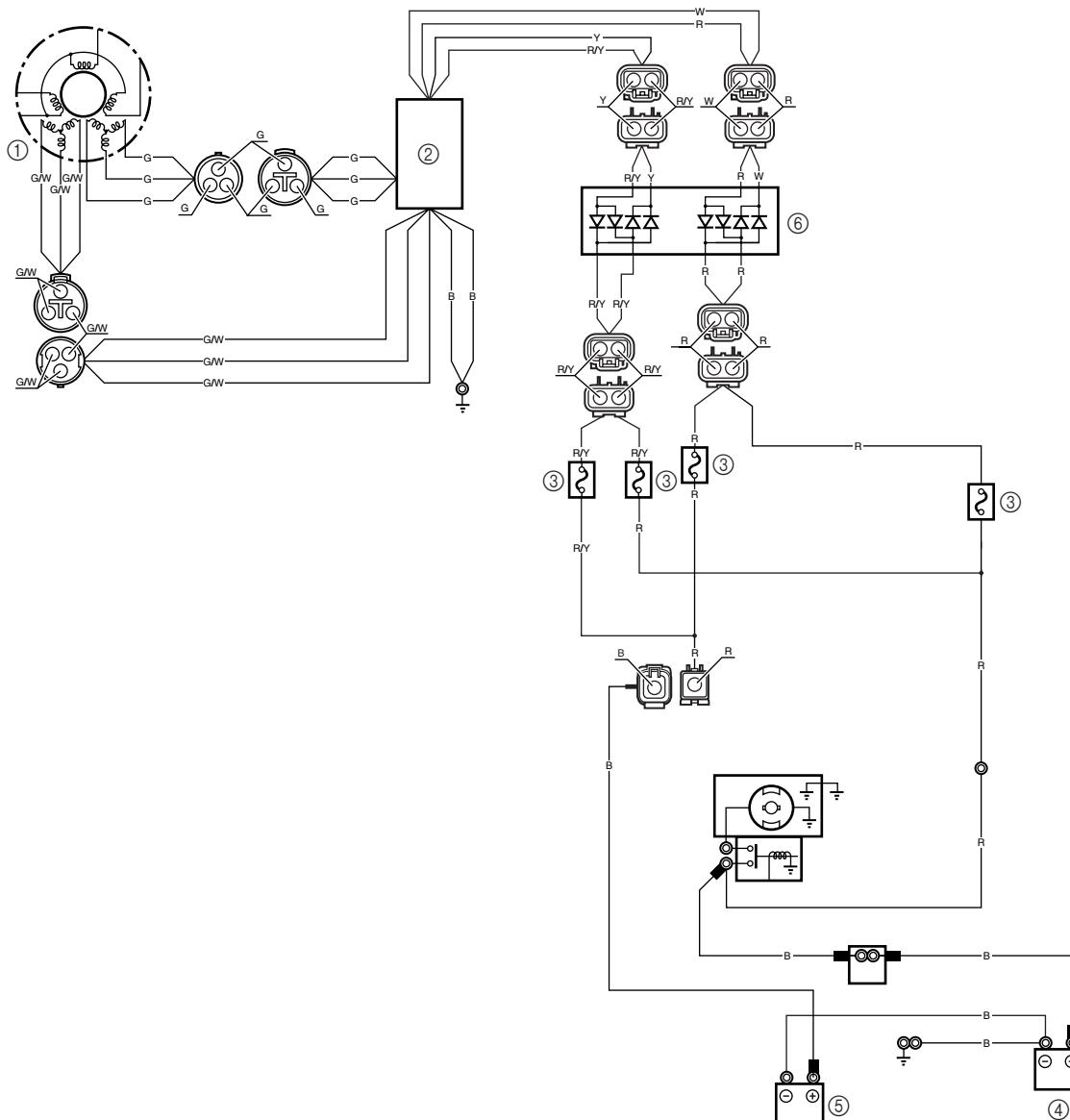
2. Check the brush holder assembly for continuity. Replace if out of specifications.



S69J8440



## Charging system



S69J8460U

- ① Stator coil
- ② Rectifier Regulator
- ③ Fuse (30 A)
- ④ Starting battery
- ⑤ Accessory battery
- ⑥ Fuel pump driver and isolator

- |     |               |
|-----|---------------|
| B   | : Black       |
| G   | : Green       |
| R   | : Red         |
| W   | : White       |
| Y   | : Yellow      |
| G/W | : Green/white |
| R/Y | : Red/yellow  |

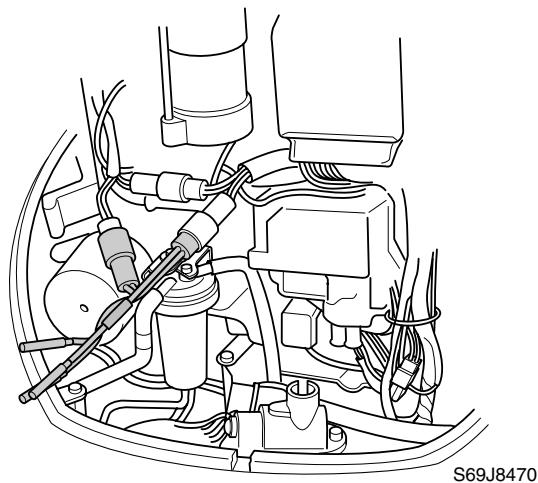
### Checking the stator coil

1. Remove the intake silencer and disconnect the stator coil coupler.
2. Connect the test harness (3 pins) to the stator coil.
3. Install the intake silencer.

**CAUTION:**

**Do not start the engine when the intake silencer is not installed.**

4. Measure the stator coil output peak voltage. Replace the stator coil if below specification.



	Digital multimeter: YU-34899-A
	Peak voltage adaptor: YU-39991
	Test harness (3 pins): YB-06770

	Stator coil output peak voltage: Green (G) – Green (G)		
r/min	Unloaded		
	Cranking	1,500	3,500
DC V	10	42	93
Green/white (G/W) – Green/white (G/W)			
r/min	Unloaded		
	Cranking	1,500	3,500
DC V	9.0	34	78



Stator coil resistance (use as reference):

Green (G) – Green (G)  
0.28–0.42 Ω at 20 °C (68 °F)  
0.24–0.36 Ω at 20 °C (68 °F)  
Green/white (G/W) –  
Green/white (G/W)  
0.24–0.36 Ω at 20 °C (68 °F)  
0.20–0.31 Ω at 20 °C (68 °F)

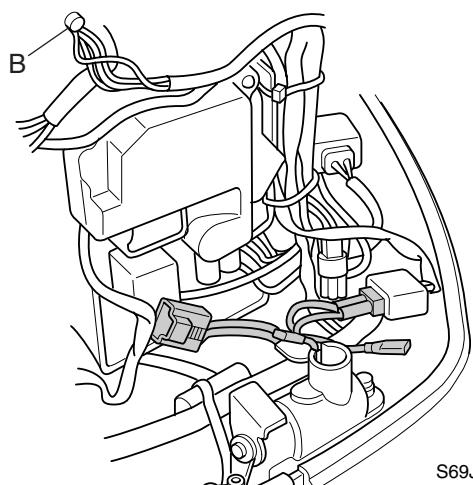
### Checking the Rectifier Regulator

1. Remove the intake silencer and disconnect the Rectifier Regulator coupler.
2. Connect the test harness (2 pins) to the Rectifier Regulator.
3. Install the intake silencer.

**CAUTION:**

**Do not start the engine when the intake silencer is not installed.**

4. Measure the Rectifier Regulator output peak voltage. If below specification, measure the stator coil output peak voltage. Replace the Rectifier Regulator if the output peak voltage of the stator coil is above specification.



**NOTE:**

Disconnect the output lead couplers (blue) of the Rectifier Regulator when measuring the output peak voltage.

**ELEC**

## Electrical systems



Digital multimeter: YU-34899-A

Peak voltage adaptor: YU-39991

Test harness (2 pins): YB-06787

Rectifier Regulator output peak  
voltage:

Red (R) – Black (B)

Red/yellow (R/Y) – Black (B)

r/min	Unloaded	
	1,500	3,500
DC V	13	13

## Troubleshooting

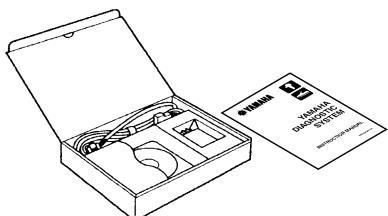
<b>Special service tools .....</b>	<b>9-1</b>
<b>Yamaha Diagnostic System .....</b>	<b>9-2</b>
Introduction .....	9-2
<b>Power unit.....</b>	<b>9-5</b>
<b>Bracket unit .....</b>	<b>9-14</b>
<b>Electrical systems.....</b>	<b>9-18</b>
<b>Self-diagnosis.....</b>	<b>9-19</b>
Diagnosing the electronic control system .....	9-19

**TRBL**  
**SHTG**



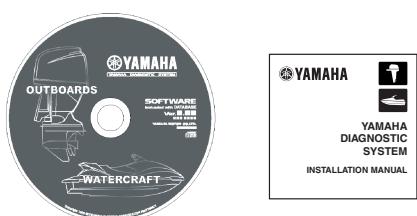
## Troubleshooting

### Special service tools



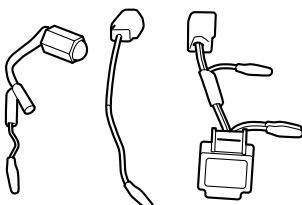
**Yamaha Diagnostic System**

**60V-85300-02**



**Yamaha Diagnostic System**

**60V-WS853-02**



**Diagnostic test lead**

**YB-06795**

## Special service tools / Yamaha Diagnostic System

### Yamaha Diagnostic System

#### Introduction

#### Features

The newly developed Yamaha Diagnostic System provides quicker detection and analysis of engine malfunctions for quicker troubleshooting procedures than traditional methods.

By connecting your computer to the ECM (Electronic Control Module) of an outboard motor using the communication cable, this software can be used to display sensor data and data stored in the ECM on a computer's monitor.

If this software is run on Microsoft Windows® 95, Windows 98, Windows Me, Windows 2000, or Windows XP the information can be displayed in colorful graphics. Also, the software can be operated using either a mouse or a keyboard.

In addition, the data for the main functions (Diagnosis, Diagnosis record, Engine monitor, and Data logger) can be saved on a disk or printed out.

#### Functions

1. **Diagnosis:** With the engine main switch ON, each sensor's status and each ECM diagnosis code or item is displayed. This enables you to find malfunctioning parts and controls quickly.
2. **Diagnosis record:** Sensors that had been activated and ECM diagnostic codes that have been recorded are displayed. This allows you to check the outboard motor's record of malfunctions.
3. **Engine monitor:** Each sensor status and the ECM data are displayed while the engine is running. This enables you to find malfunctioning parts quickly.
4. **Stationary test:** With the engine off, the ignition, fuel injection, electric fuel pump, and ISC valve are checked. These tests can be performed quickly.
5. **Active test:** With the engine running the ISC valve is checked.
6. **Data logger:** Displays 13 minutes of recorded data for two or more of the items stored in the ECM. In addition, the operating time as compared to the engine speed and the total operating time are displayed. This allows you to check the operating status of the engine.
7. **Some files:** Lets you select and run other applications while continuing to run the diagnostic program.

#### Contents

1. Software (1)
2. Adapter (1)
3. Communication cable (1)
4. Instruction Manual (1)
5. Installation Manual (1)



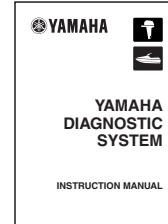
①



②



③



④



⑤

9

**Hardware requirements**

Make sure that your computer meets the following requirements before using this software.

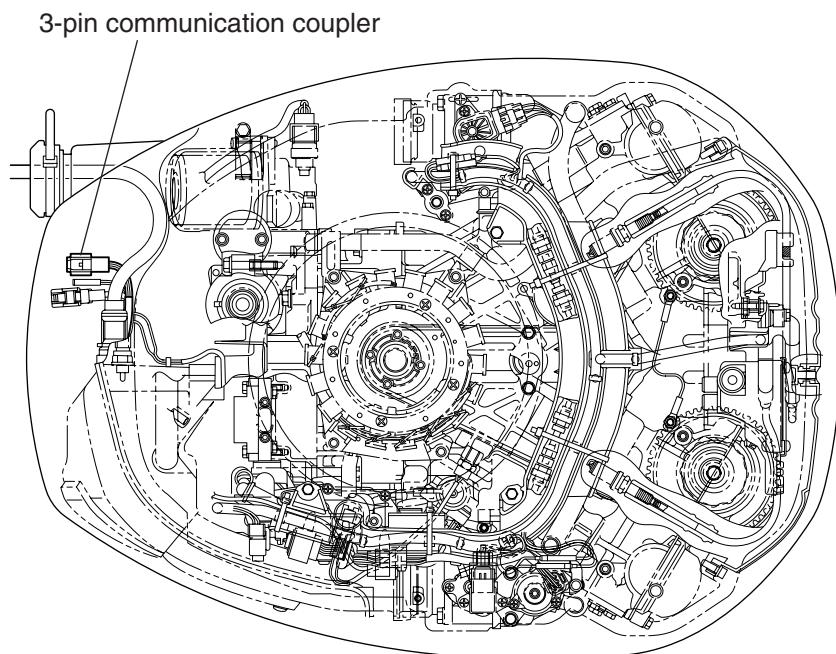
Computer:	IBM-compatible computer
Operating system:	Microsoft (Windows 95,) Windows 98, Windows Me, Windows 2000, or Windows XP (English version)
CPU:	
Windows 95/98:	i486X, 100 MHz or higher (Pentium 100 MHz or higher recommended)
Windows Me/2000:	Pentium, 166 MHz or higher (Pentium 233 MHz or higher recommended)
Windows XP:	Pentium, 300 MHz or higher (Pentium 500 MHz or higher recommended)
Memory:	
Windows 95/98:	16 MB or more (32 MB or more recommended)
Windows Me:	32 MB or more (64 MB or more recommended)
Windows 2000:	64 MB or more (128 MB or more recommended)
Windows XP:	128 MB or more (256 MB or more recommended)
Hard disk free space:	20 MB or more (40 MB or more recommended)
Drive:	CD-ROM drive
Display:	VGA (640 × 480 pixels), (SVGA [800 × 600 pixels] or more recommended) 256 or more colors
Mouse:	Compatible with the operating systems mentioned above
Communication port:	RS232C (Dsub-9 pin) port, USB port
Printer:	Compatible with the operating systems mentioned above

**NOTE:**

- The amount of memory and the amount of free space on the hard disk differs depending on the computer.
- Using this software while there is not enough free space on the hard disk could cause errors and result in insufficient memory.
- This software will not run properly on some computers.
- When starting up this program, do not start other software applications.
- Do not use the screen saver function or the energy saving feature when using this program.
- If the ECM is changed, restart the program.
- Window XP is a multiuser operating system, therefore, be sure to end this program if the login user is changed.
- The USB adapter cannot be used with Windows 95.

For operating instructions of the Yamaha Diagnostic System, refer to the "Yamaha Diagnostic System Instruction Manual."

### **Connecting the communication cable to the outboard motor**



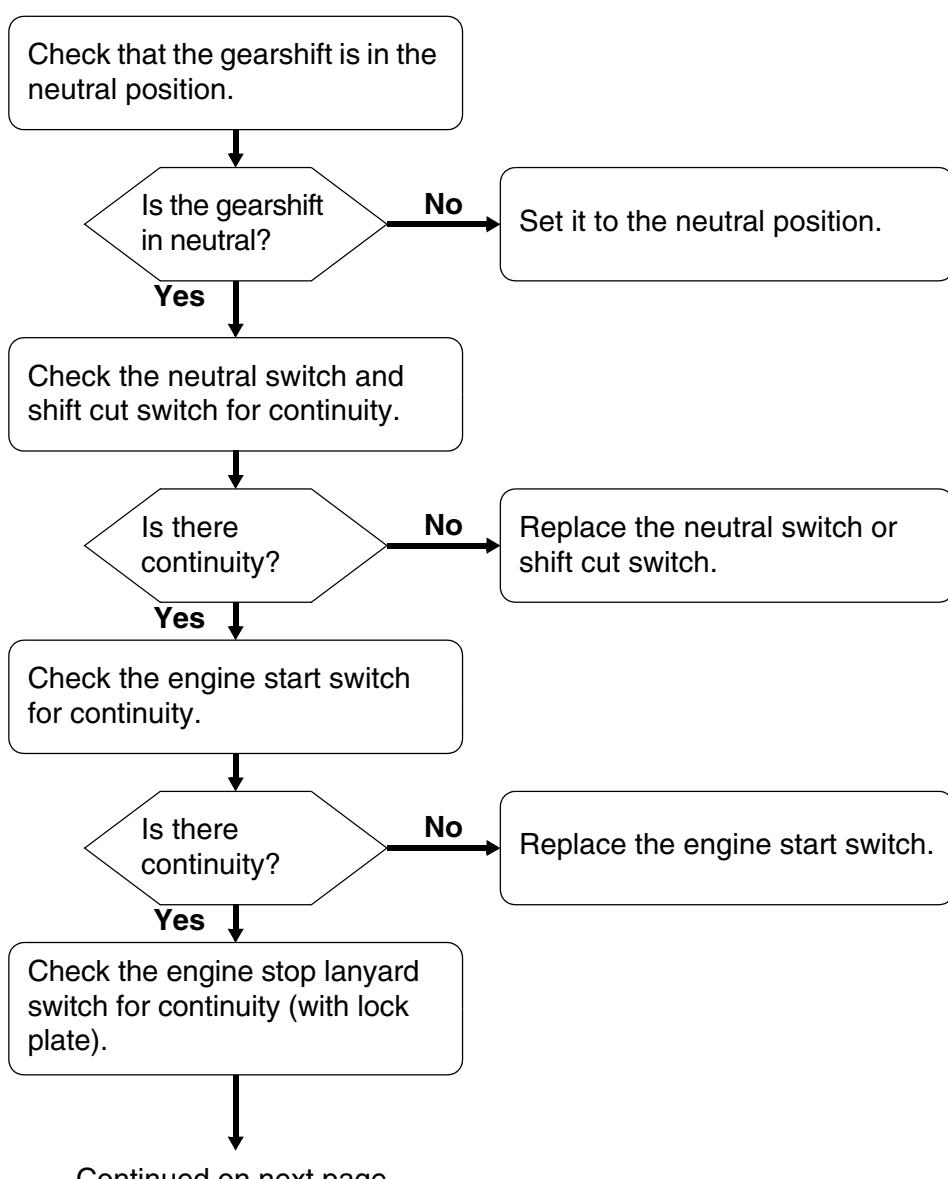
**NOTE:**

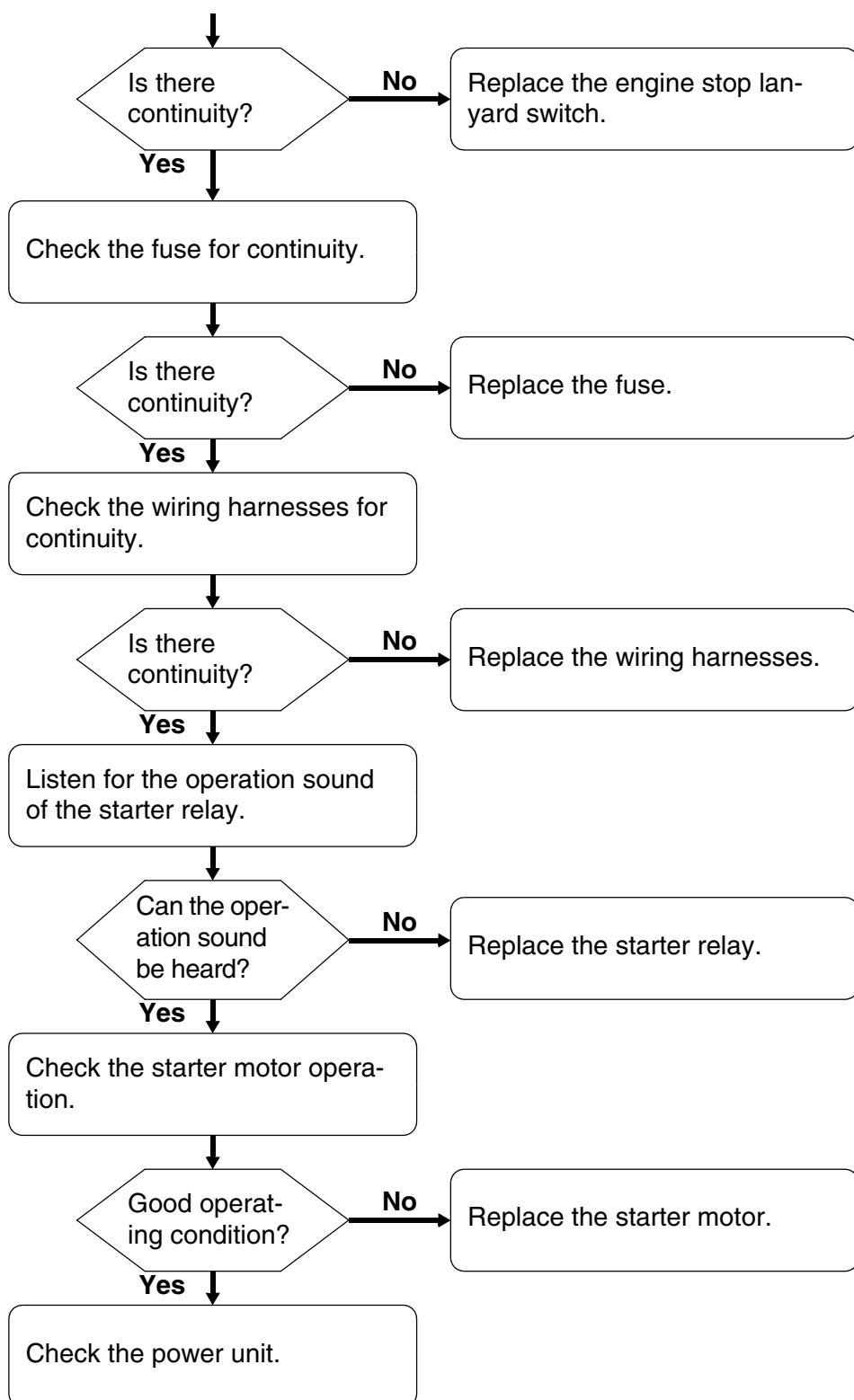
- To diagnose a mechanical malfunction, use the troubleshooting charts pertaining to the trouble located in this chapter. Also, when checking and maintaining the outboard motor, see Chapters 4–8 for safe maintenance procedures.
- Check that all electrical connections are tight and free from corrosion, and that the battery is fully charged to 12 V.
- To diagnose a malfunctioning sensor or switch, use the diagnostic flash indicator to determine the cause.

## Power unit

### Symptom: Engine does not crank.

- Check the starting system.
- Check the power unit.

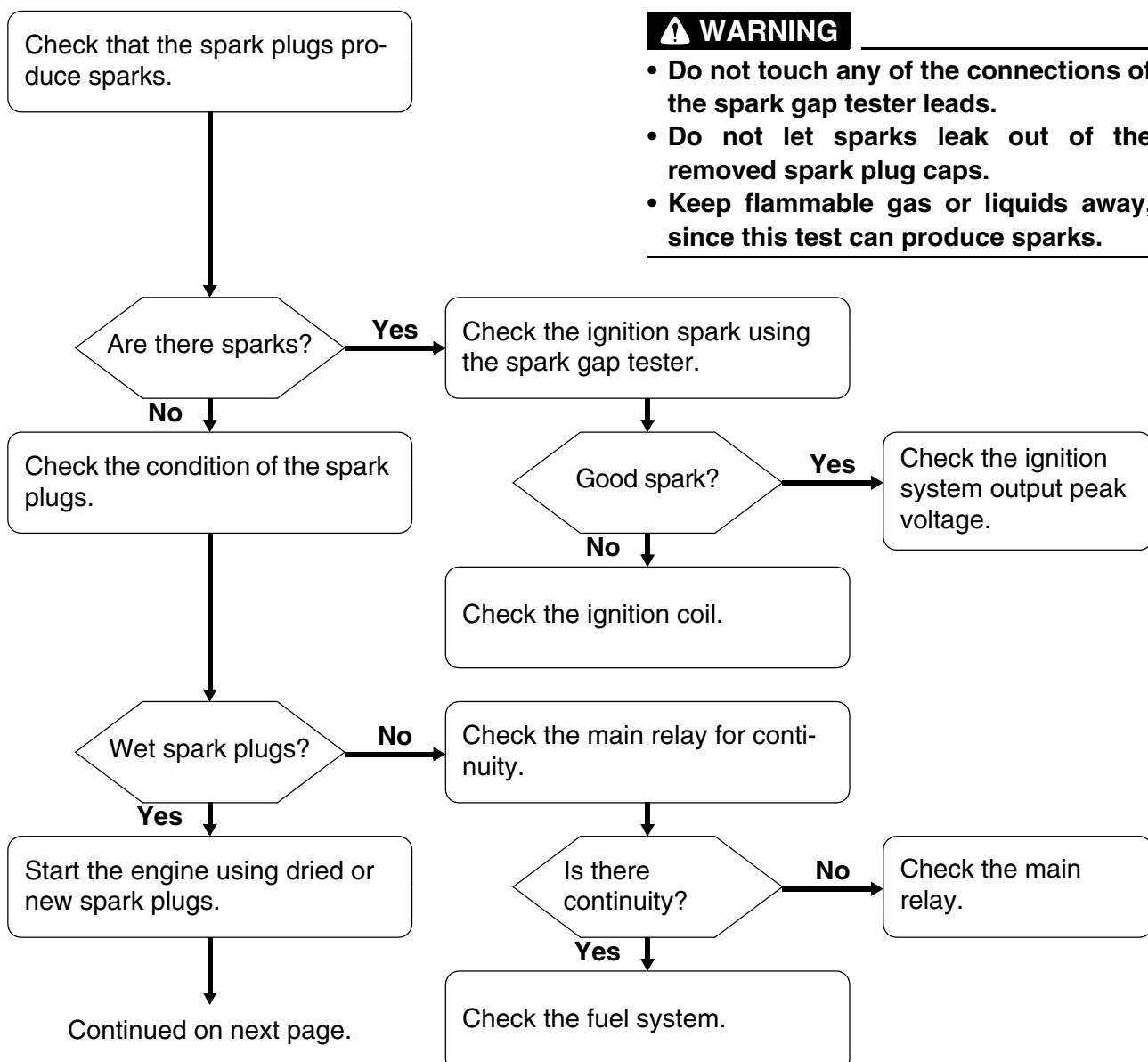






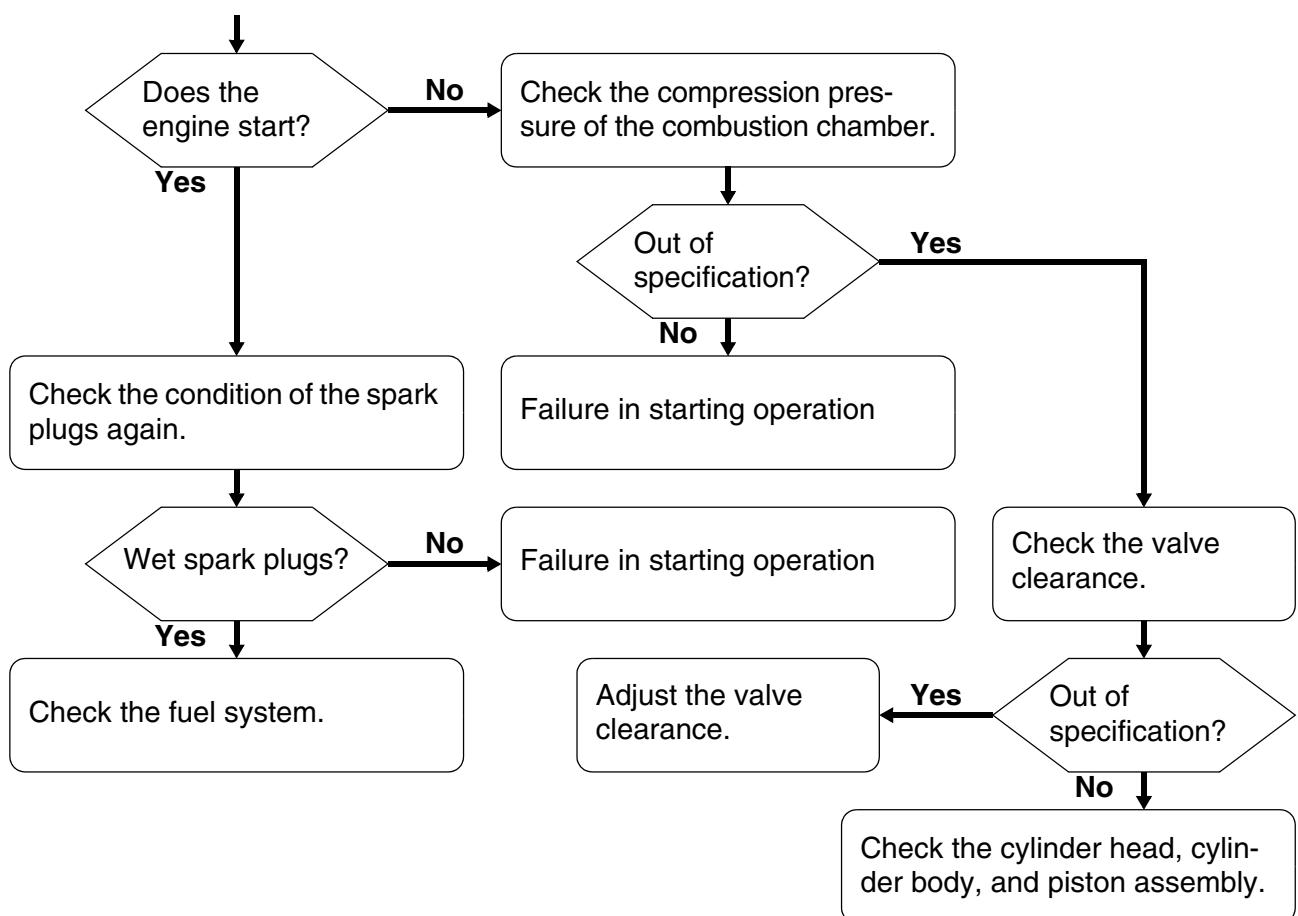
**Symptom:** Engine cranks, but will not start (engine stop lanyard switch is operating normally).

- Check the ignition system.
- Check the fuel system.
- Check the compression pressure of the power unit.



**WARNING**

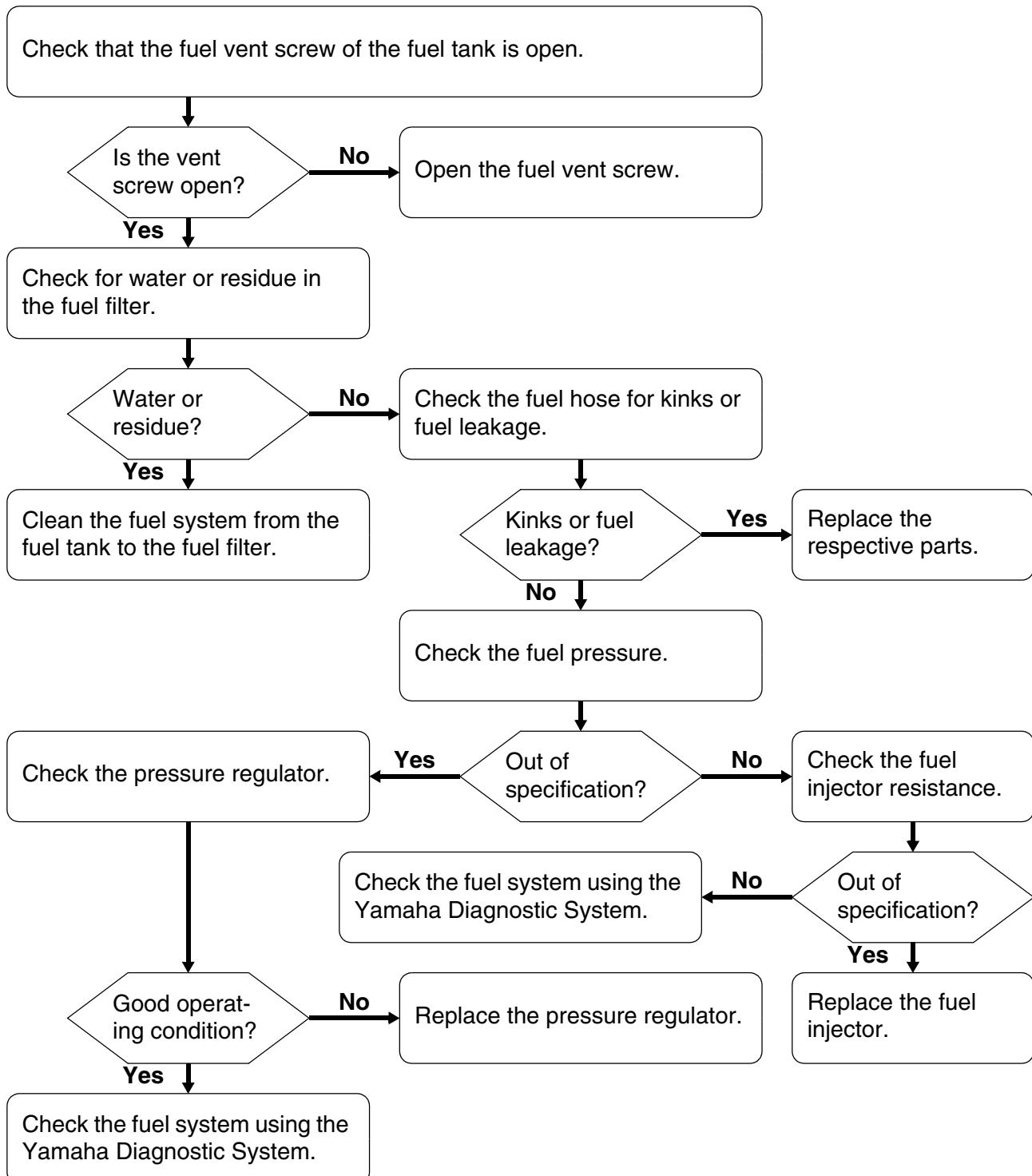
- Do not touch any of the connections of the spark gap tester leads.
- Do not let sparks leak out of the removed spark plug caps.
- Keep flammable gas or liquids away, since this test can produce sparks.



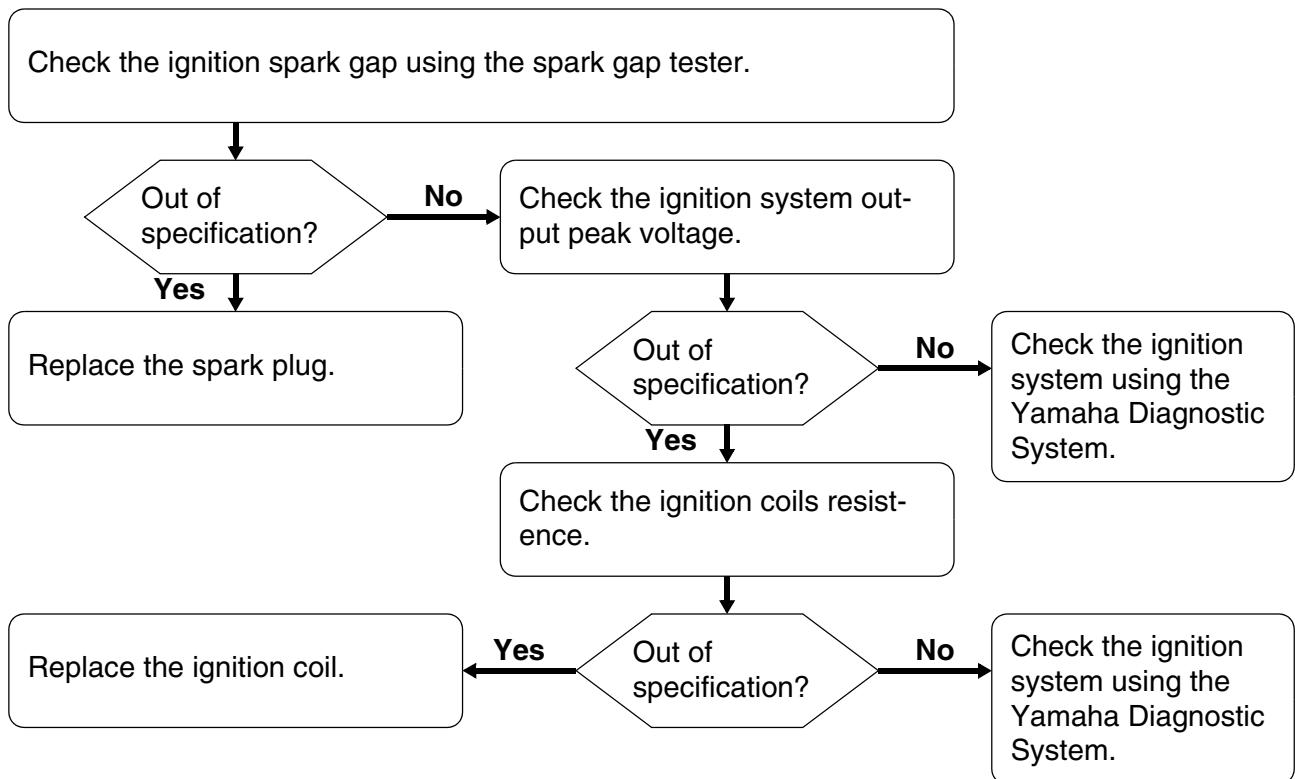
**Symptom: Engine can be started, but does not remain on.**

- Check the fuel system.
- Check the ignition system.
- Check the compression pressure of the power unit.

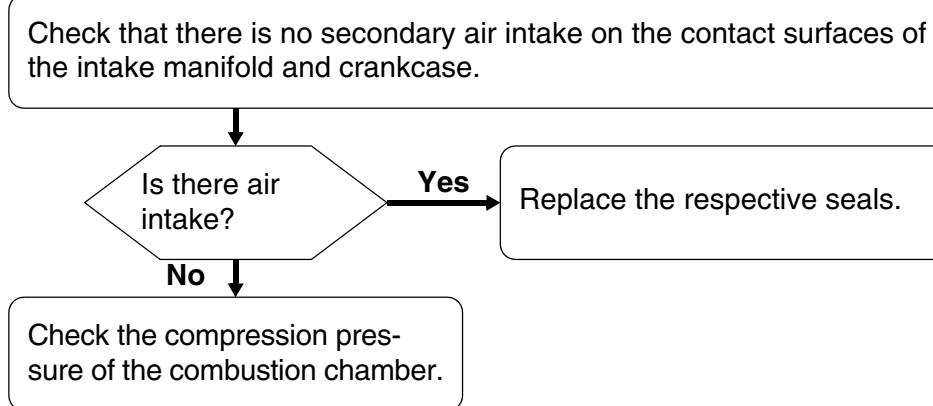
### Fuel system



### **Ignition system**

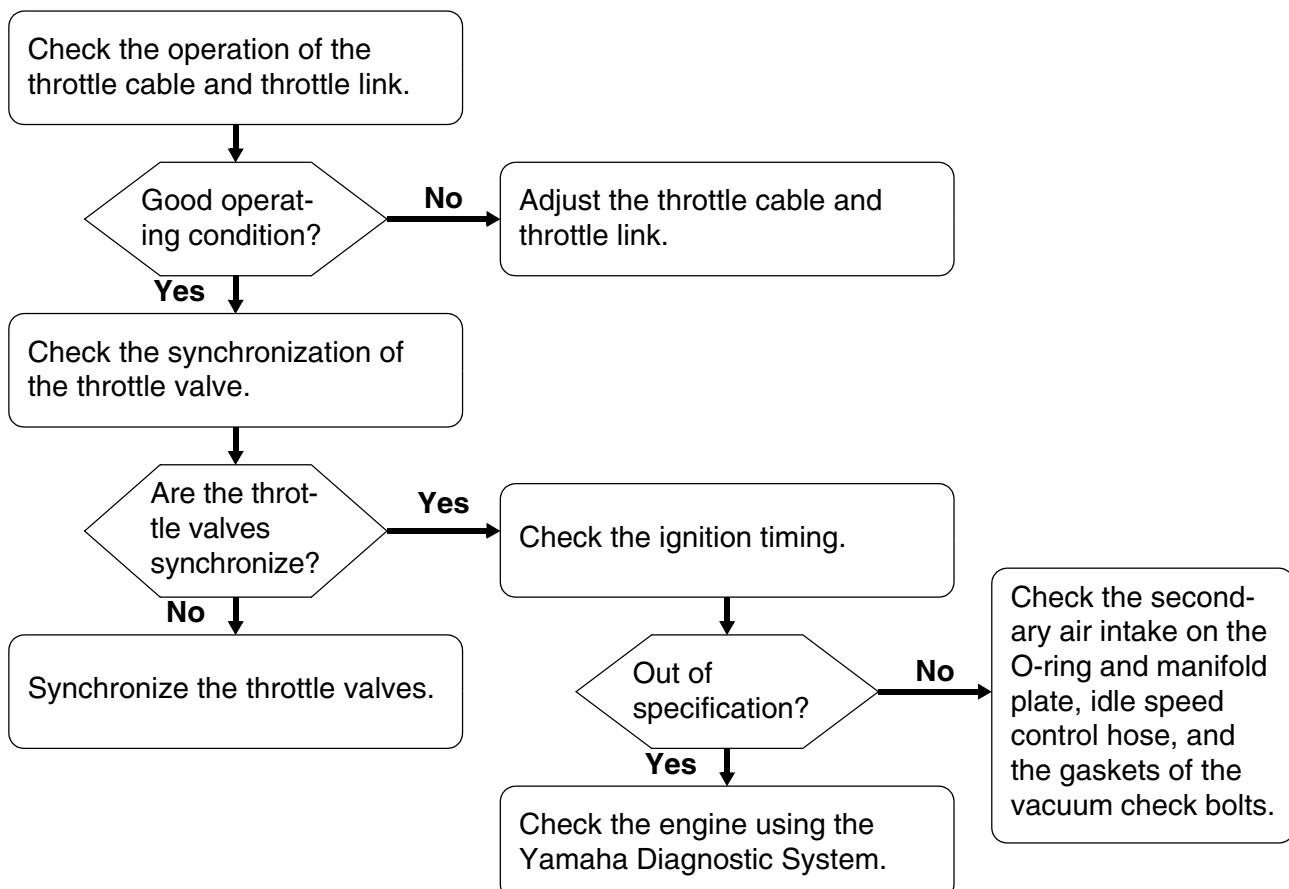


### **Compression pressure**



**Symptom: The engine idle speed is not steady, but increases or decreases.**

- Check the intake manifold.
- Check the air intake system.
- Check the ignition system.



**Symptom: Engine does not accelerate when the throttle is opened quickly.**

The engine turns off when the throttle is opened quickly.

Acceleration is tardy and the engine is likely to stop at any moment.

- Check the engine using the diagnostic flash indicator or the Yamaha Diagnostic System.

**Symptom: Engine can run, but engine speed will not increase.**

Overheat warning indicator is on.

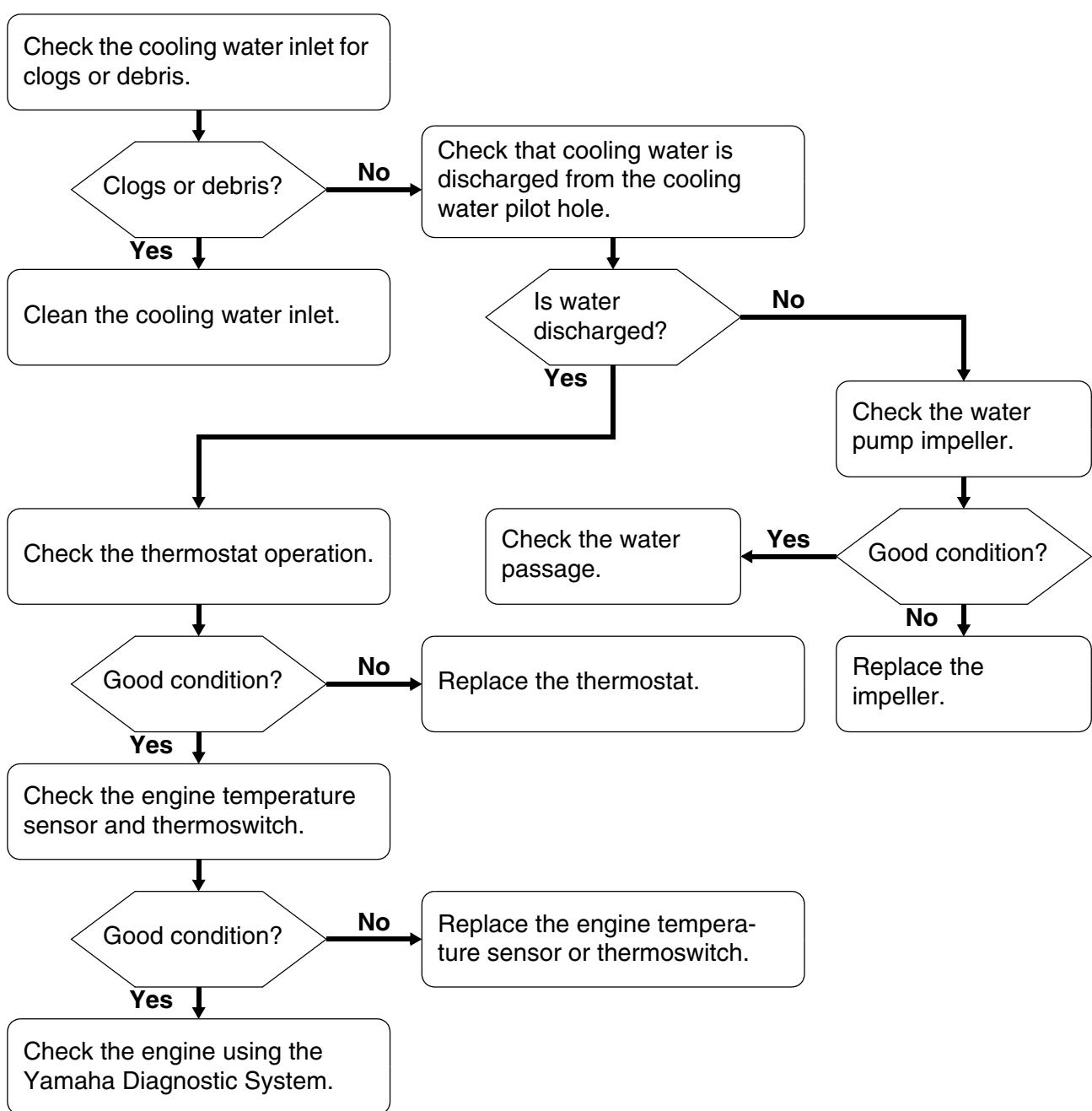
Oil pressure warning indicator is on.

Warning indicator is on and buzzer is sounding.

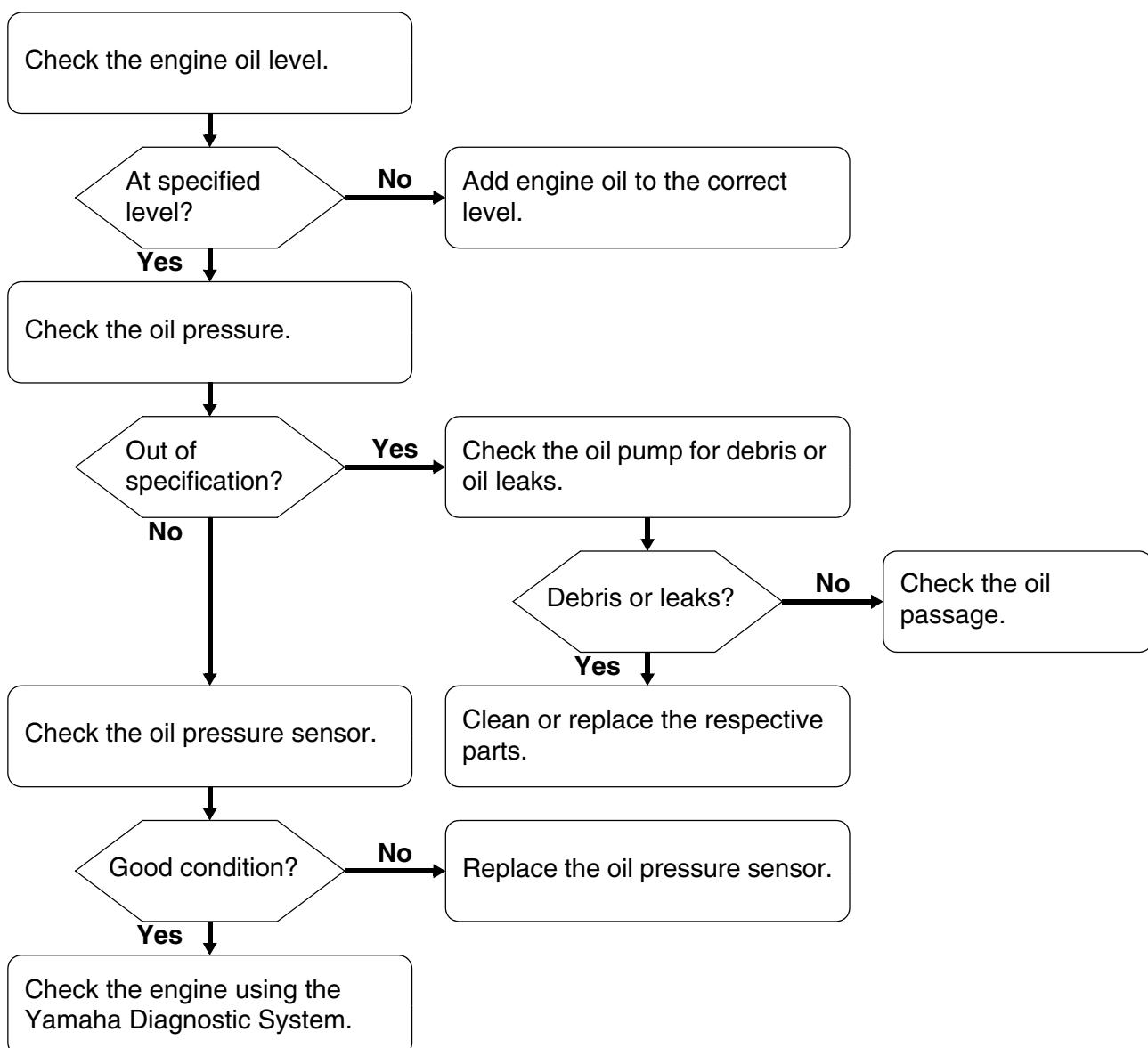
- Check the cooling system.

- Check the lubrication system.

**Cooling system**

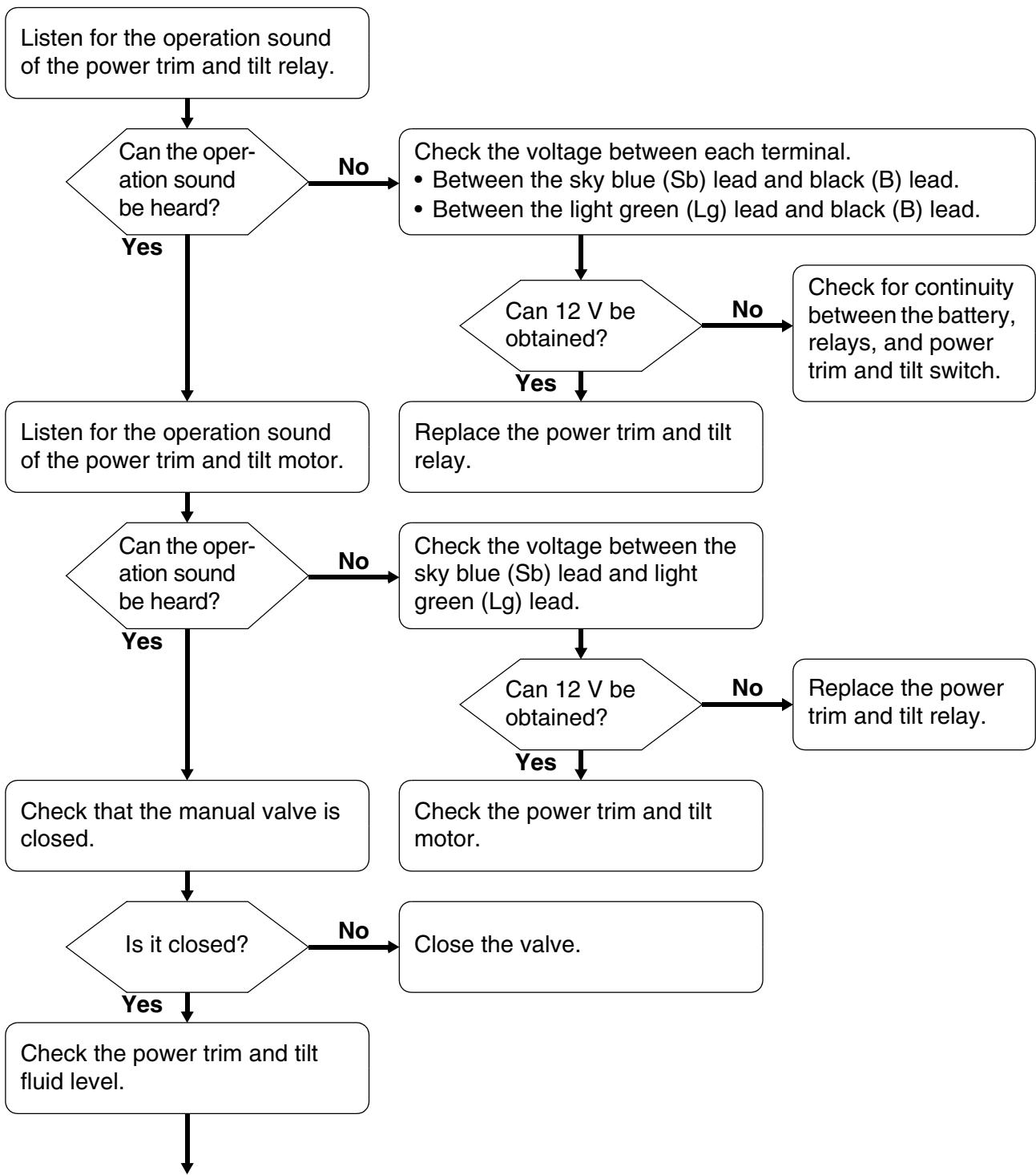


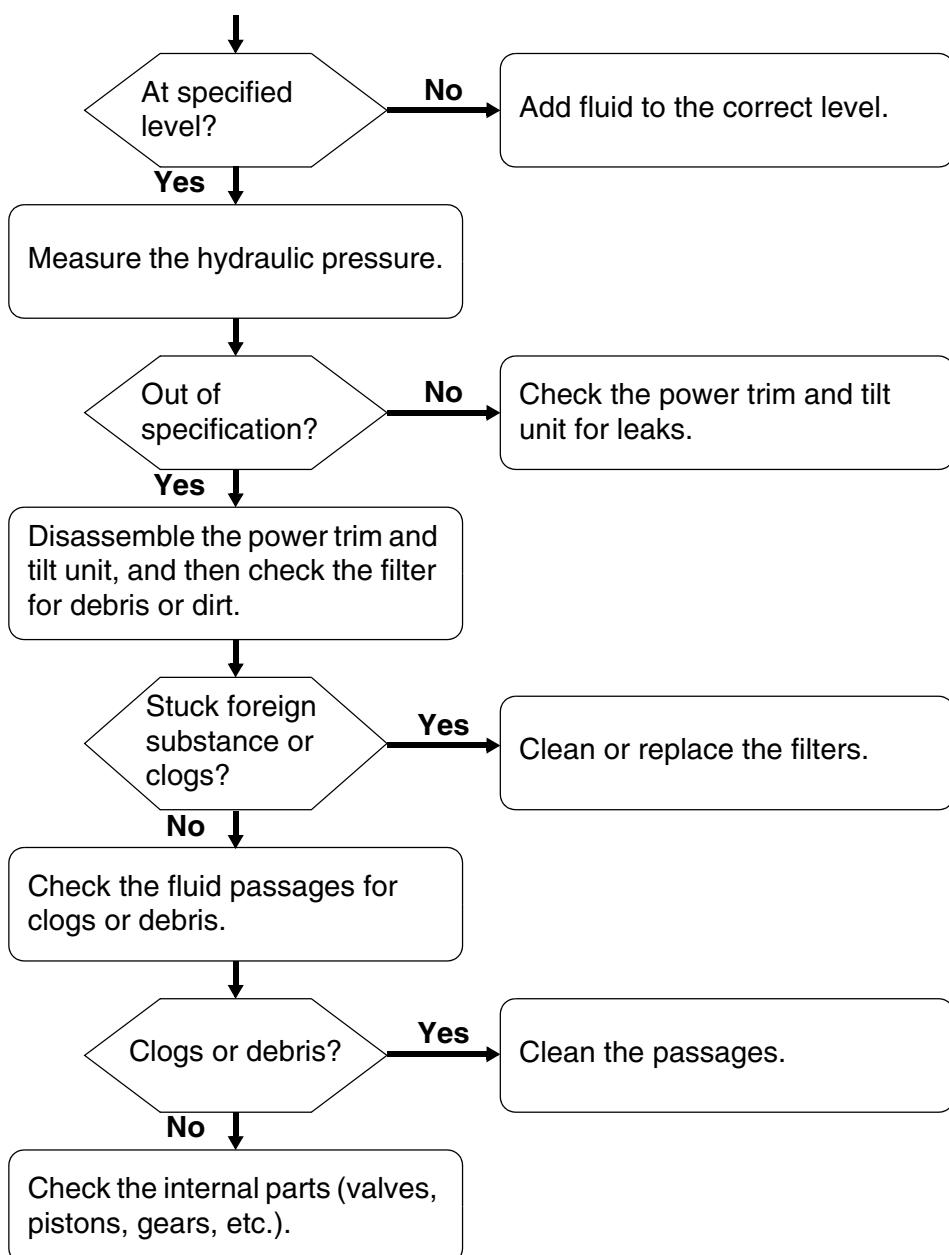
## Lubrication system



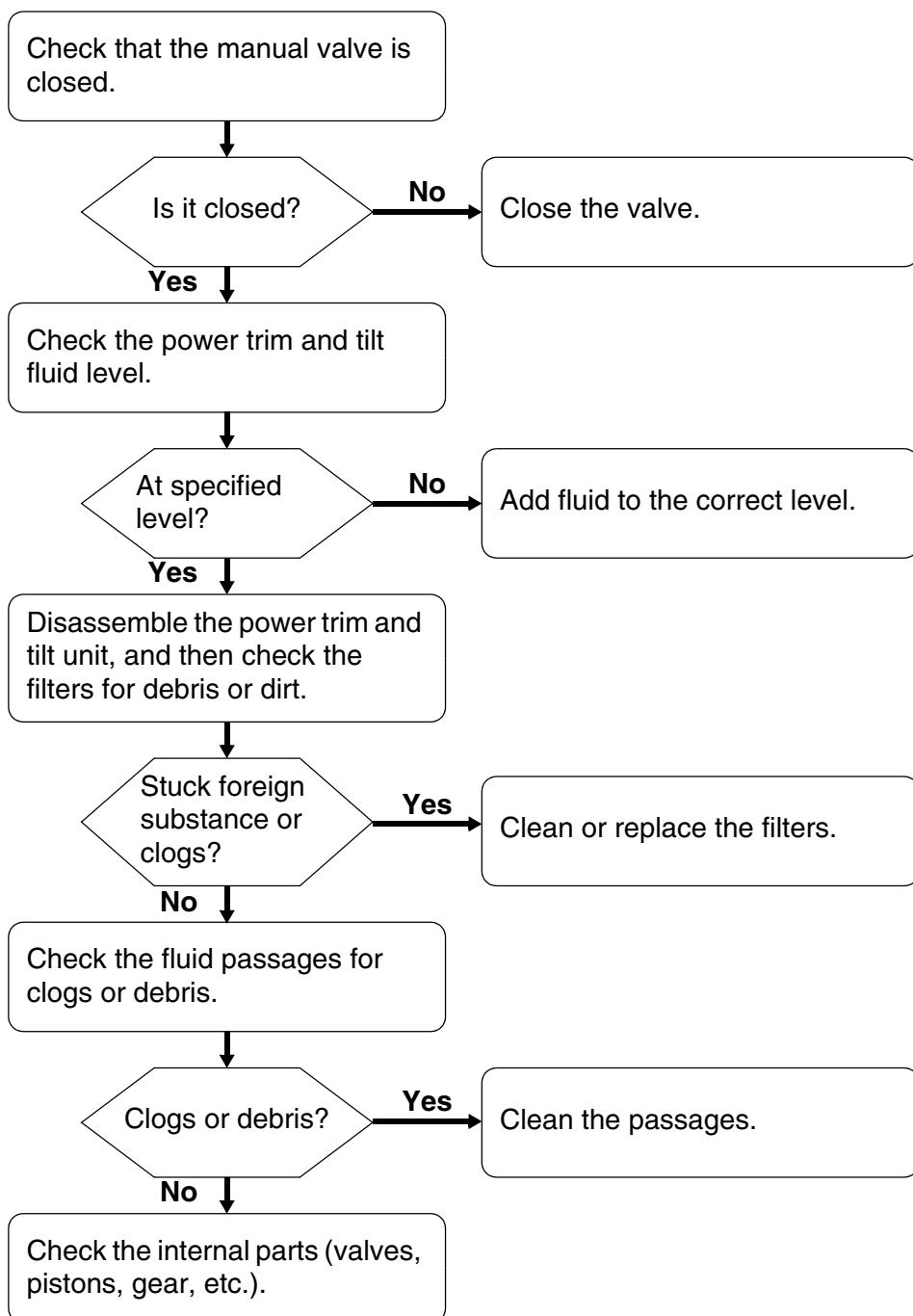
## Bracket unit

Symptom: Power trim and tilt unit does not operate.

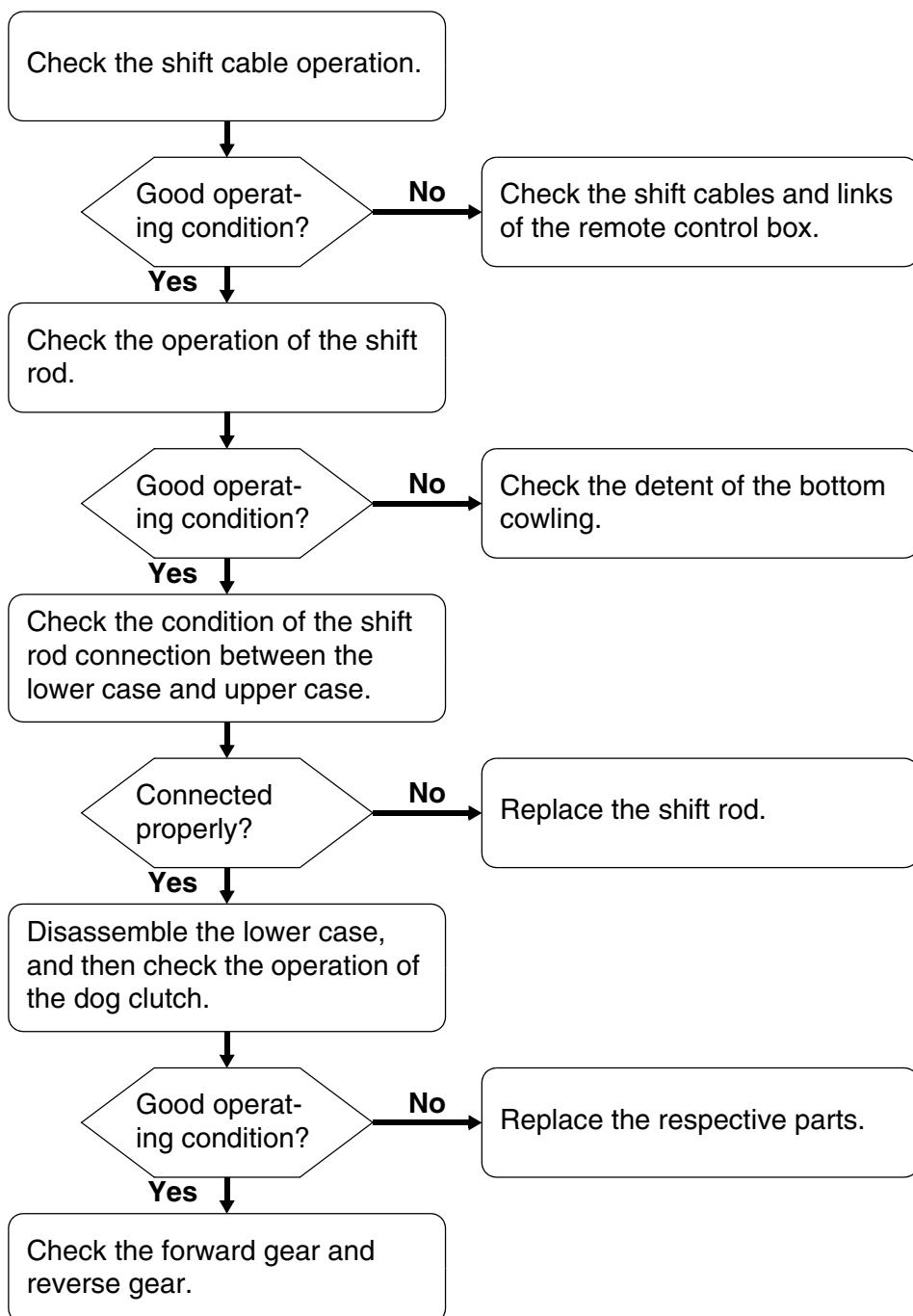




**Symptom:** Power trim and tilt unit does not hold the outboard motor up.



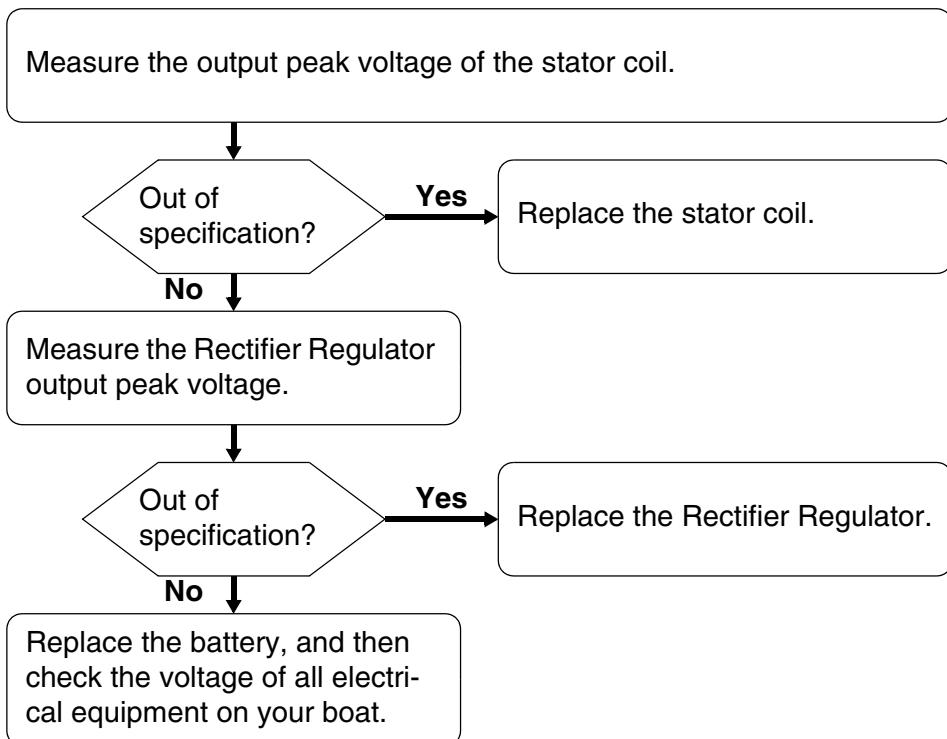
Symptom: Shift mechanism of the forward gear and reverse gear does not operate properly.



### Electrical systems

**Symptom:** Battery becomes weaker quickly.

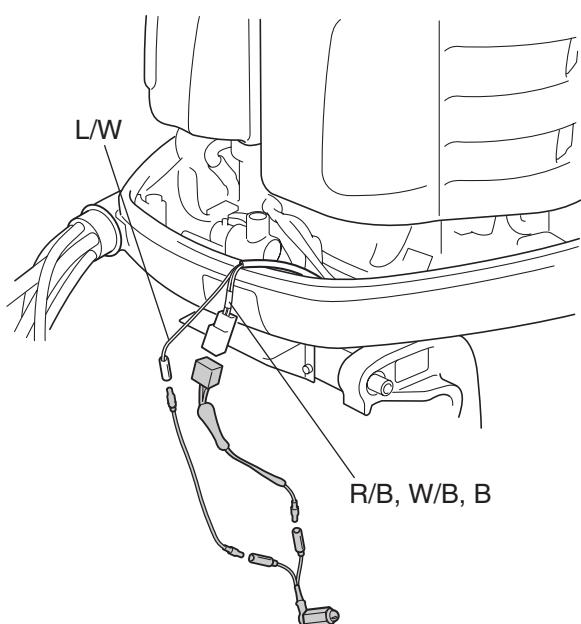
- Check the charging system.



## Self-diagnosis

### Diagnosing the electronic control system

1. Connect the special tools to the outboard motor as shown.



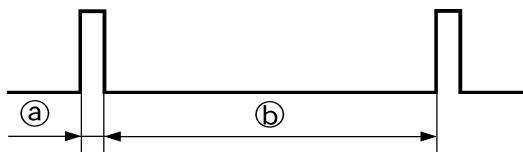
#### NOTE:

When performing this diagnosis, all of the electrical wires must be properly connected.



Diagnostic test lead: YB-06795

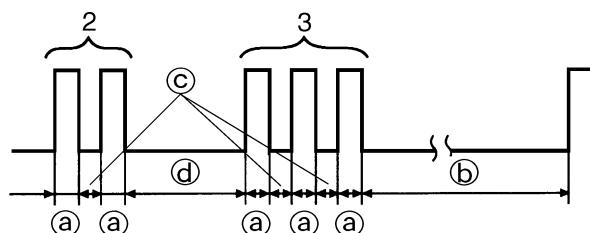
2. Start the engine and let it idle.
3. Check the flash pattern of the diagnostic indicator to determine if there are any malfunctions.
  - Normal condition  
(no defective part or irregular processing is found)
  - Single flash is given every 4.95 seconds.
    - ⓐ: Light on, 0.33 second
    - ⓑ: Light off, 4.95 seconds



- Trouble code indication

Example: The illustration indicates code number 23.

- ⓐ: Light on, 0.33 second
- ⓑ: Light off, 4.95 seconds
- ⓑ: Light off, 0.33 second
- ⓓ: Light off, 1.65 seconds



4. If a flash pattern listed in the diagnosis code chart is displayed, check the malfunctioning part according to the flash pattern.

#### NOTE:

When more than one problem is detected, the light of the diagnostic tester flashes in the pattern of the lowest numbered problem. After that problem is corrected, the light flashes in the pattern of the next lowest numbered problem. This continues until all of the problems are detected and corrected.

Code	Symptom
1	Normal
13	Incorrect pulser coil signal
15	Incorrect engine temperature sensor signal
18	Incorrect throttle position sensor signal
19	Incorrect battery voltage
23	Incorrect intake air temperature sensor signal
28	Incorrect neutral switch signal
29	Incorrect intake air pressure sensor signal
37	Incorrect idle speed control signal
39	Incorrect oil pressure sensor signal
44	Incorrect engine stop lanyard switch signal
45	Incorrect shift cut switch signal
46	Incorrect thermoswitch signal

# Index

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## A.

- Adjusting the throttle link and throttle cable operation (with a stop bolt) ..... 3-10
- Adjusting the throttle link and throttle cable operation (without a stop bolt) ..... 3-11
- Adjusting the trim sensor ..... 7-19
- After test run ..... 1-31
- Applicable models ..... 1-4
- Assembling the drive shaft
  - housing ..... 6-19, 6-45
- Assembling the forward gear ..... 6-19
- Assembling the gear pump ..... 7-35
- Assembling the lower case ..... 6-18, 6-44
- Assembling the oil pan ..... 7-13
- Assembling the oil pump ..... 5-55
- Assembling the piston and cylinder block ..... 5-56
- Assembling the power trim and tilt motor ..... 7-28
- Assembling the propeller shaft
  - assembly ..... 6-13
  - housing ..... 6-13, 6-39
- Assembling the tilt ram ..... 7-36
- Assembling the trim rams ..... 7-37

## B.

- Backlash (counter rotation model) ..... 6-54
- Backlash (regular rotation model) ..... 6-28
- Bleeding the power trim and tilt unit ..... 7-41
- Bottom cowling ..... 7-3
- Bracket unit ..... 9-14
- Break-in ..... 1-31
- Built-in ..... 7-42

## C.

- Changing the engine oil by draining it ..... 3-6
- Changing the engine oil using an oil changer ..... 3-6
- Changing the gear oil ..... 3-17
- Charging system ..... 8-25
- Checking the anodes ..... 3-18
- Checking the armature ..... 8-23
- Checking the battery ..... 1-28, 3-19
- Checking the bearings ..... 6-18, 6-44
- Checking the brushes ..... 8-24
- Checking the camshaft ..... 5-38
- Checking the check valve ..... 4-7
- Checking the compression pressure ..... 5-14
- Checking the connecting rod big end side clearance ..... 5-50
- Checking the connecting rod small end inside diameter ..... 5-50

- Checking the cooling water passage ..... 3-9
- Checking the cooling water pilot hole ..... 1-31
- Checking the crankpin oil clearance ..... 5-51
- Checking the crankshaft ..... 5-50
- Checking the crankshaft main journal oil clearance ..... 5-53
- Checking the cylinder bore ..... 5-48
- Checking the cylinder head ..... 5-39
- Checking the drive shaft ..... 6-18, 6-44
- Checking the ECM ..... 8-12
- Checking the electrical components ..... 8-2
- Checking the engine idle speed ..... 3-13
- Checking the engine oil ..... 1-28, 3-5
- Checking the engine start switch and engine stop lanyard switch ..... 1-30
- Checking the engine temperature sensor ..... 8-13
- Checking the filters ..... 7-35
- Checking the fuel filter ..... 3-5
- Checking the fuel injector ..... 4-15
- Checking the fuel joint and fuel hoses (fuel joint-to-fuel injector) ..... 3-4
- Checking the fuel system ..... 1-28
- Checking the fuse ..... 7-44, 8-20
- Checking the gear oil ..... 1-28
- Checking the gear oil level ..... 3-16
- Checking the gear pump ..... 7-35
- Checking the gear pump housing ..... 7-35
- Checking the gearshift and throttle operation ..... 1-30
- Checking the gearshift operation ..... 3-12
- Checking the hydraulic pressure ..... 7-29
- Checking the idle speed control (ISC) ..... 4-15
- Checking the ignition coil ..... 8-11
- Checking the ignition spark gap ..... 8-11
- Checking the ignition timing ..... 3-15
- Checking the intake air temperature sensor ..... 8-13
- Checking the lower case ..... 6-18, 6-44
- Checking the lower unit (for air leakage) ..... 3-18
- Checking the low-pressure fuel pump and high-pressure fuel pump ..... 8-18
- Checking the magnet switch ..... 8-24
- Checking the main relay ..... 8-15
- Checking the neutral switch ..... 8-14
- Checking the oil pressure ..... 5-14
- Checking the oil pressure sensor ..... 5-15
- Checking the oil pump ..... 5-55
- Checking the oil strainer ..... 7-13
- Checking the outboard motor mounting height ..... 1-29
- Checking the pinion and forward gear ..... 6-18
- Checking the pinion and reverse gear ..... 6-44

---

Checking the piston clearance .....	5-48
Checking the piston diameter .....	5-47
Checking the piston pin.....	5-50
Checking the piston pin boss bore.....	5-49
Checking the piston ring grooves.....	5-49
Checking the piston ring side clearance ...	5-49
Checking the piston rings.....	5-48
Checking the power trim and tilt fluid level.....	3-16
Checking the power trim and tilt motor .....	7-27
Checking the power trim and tilt operation.....	3-15
Checking the power trim and tilt relay.....	7-44
Checking the power trim and tilt switch.....	7-45
Checking the propeller .....	3-18
Checking the propeller shaft .....	6-12, 6-38
Checking the propeller shaft housing .....	6-12, 6-38
Checking the pulser coil.....	8-12
Checking the Rectifier Regulator .....	8-26
Checking the remote control cables.....	1-29
Checking the reservoir .....	7-34
Checking the shift cut switch.....	8-14
Checking the spark plugs.....	3-8
Checking the starter motor operation.....	8-24
Checking the starter motor pinion .....	8-23
Checking the starter relay .....	8-20
Checking the stator coil.....	8-26
Checking the steering wheel.....	1-30
Checking the thermostat .....	3-9, 5-60
Checking the thermoswitch.....	8-14
Checking the throttle link and throttle cable operation .....	3-9
Checking the throttle position sensor.....	8-12
Checking the tilt cylinder and trim cylinder.....	7-34
Checking the tilt system .....	1-30
Checking the timing belt.....	3-8
Checking the timing belt and sprockets ....	5-26
Checking the timing chain .....	5-39
Checking the timing chain tensioner .....	5-39
Checking the top cowling .....	3-4
Checking the trim sensor .....	7-45
Checking the valve clearance .....	3-8, 5-15
Checking the valve guides .....	5-35
Checking the valve seat.....	5-36
Checking the valve springs .....	5-34
Checking the valves .....	5-34, 7-34
Checking the vapor separator .....	4-8
Checking the water pump and shift rod .....	6-8, 6-34
Checking the wiring harness (10 pins).....	8-20
Control system .....	3-9

Cooling system .....	1-26
Cylinder block .....	5-43
Cylinder head .....	5-29

## D.

Diagnosing the electronic control system ..	9-19
Dimensions .....	2-11
Disassembling the cylinder block .....	5-47
Disassembling the drive shaft housing .....	6-17, 6-43
Disassembling the forward gear .....	6-17
Disassembling the gear pump .....	7-31
Disassembling the lower case .....	6-17, 6-43
Disassembling the oil pan.....	7-13
Disassembling the oil pump.....	5-55
Disassembling the power trim and tilt motor .....	7-27
Disassembling the propeller shaft assembly .....	6-11
Disassembling the propeller shaft housing .....	6-11, 6-37
Disassembling the reverse gear .....	6-43
Disassembling the tilt cylinder and trim cylinders .....	7-32
Disassembly and assembly .....	1-4
Disconnecting the high-pressure fuel hose joint .....	4-15
Draining the engine oil .....	7-13
Drive shaft and lower case (counter rotation model) .....	6-41
Drive shaft and lower case (regular rotation model) .....	6-15

## E.

Electrical .....	2-7
Electrical components .....	8-3
Electrical systems .....	9-18
Exhaust system .....	1-11

## F.

Fail-safe function table .....	1-20
Features and benefits .....	1-6
Fire prevention.....	1-3
Front view .....	8-5
Fuel and blowby hoses .....	4-2
Fuel control system .....	8-16
Fuel injection control.....	1-18
Fuel system .....	1-13, 3-4

# **Index**

---

## **G.**

General .....	3-18
General specifications.....	2-1
General torques .....	2-17
Good working practices .....	1-4

## **H.**

Hose routing.....	4-2
How to use this manual.....	1-1

## **I.**

Identification.....	1-4
Ignition and ignition control system.....	8-10
Installing the clamp brackets.....	7-18
Installing the cylinder head .....	5-41
Installing the drive shaft .....	6-19, 6-46
Installing the hose clamps.....	4-7
Installing the lower unit .....	6-22, 6-48
Installing the power trim and tilt motor .....	7-39
Installing the power trim and tilt unit.....	7-18
Installing the power unit .....	5-60
Installing the propeller shaft housing .....	6-20, 6-46
Installing the reservoir.....	7-40
Installing the sprockets and timing belt .....	5-27
Installing the steering arm.....	7-16
Installing the tilt cylinder.....	7-38
Installing the tilt ram .....	7-40
Installing the trim rams .....	7-38
Installing the upper case .....	7-17
Installing the valves.....	5-40
Installing the water pump and shift rod .....	6-20, 6-47
Intake manifold and high-pressure fuel line.....	4-9
Intake silencer, fuel filter, and fuel pump .....	4-3
Intake system.....	1-11
Introduction .....	9-2

## **L.**

Lower unit .....	2-6, 3-16
Lower unit (counter rotation model) .....	6-30
Lower unit (regular rotation model) .....	6-4
Lubrication .....	3-20
Lubrication system .....	1-26

## **M.**

Maintenance interval chart.....	3-2
Maintenance specifications.....	2-3
Manual format .....	1-1

Measuring the forward and reverse gear backlash .....	6-28, 6-54
Measuring the fuel pressure (high-pressure fuel line).....	3-5
Measuring the lower resistance.....	8-2
Measuring the peak voltage .....	8-2

## **N.**

Newly developed V6 4-stroke engine .....	1-6
Not installed.....	7-41

## **P.**

Parts, lubricants, and sealants .....	1-3
Port view .....	8-4
Power trim and tilt electrical system .....	7-43
Power trim and tilt unit .....	3-15, 7-21
Power unit.....	2-3, 3-5, 5-3, 9-5
Predelivery checks .....	1-28
Propeller selection .....	1-27
Propeller shaft housing (counter rotation model) .....	6-35
Propeller shaft housing (regular rotation model) .....	6-9
Propeller size.....	1-27
PTT (Power trim and tilt) unit.....	1-17, 1-21

## **R.**

Reducing the fuel pressure.....	4-7
Refacing the valve seat .....	5-36
Removing the clamp brackets .....	7-18
Removing the cylinder head .....	5-33
Removing the drive shaft.....	6-17, 6-43
Removing the hose clamps .....	4-7
Removing the lower unit .....	6-7, 6-33
Removing the oil filter .....	5-25
Removing the power trim and tilt unit .....	7-17
Removing the power unit.....	5-23
Replacing the pressure regulator .....	4-15
Replacing the propeller shaft housing assembly .....	6-11, 6-37
Replacing the oil filter .....	3-7
Replacing the timing belt .....	3-8, 5-21
Replacing the valve guides.....	5-35

---

## S.

Safety while working .....	1-3
Selecting the connecting rod bearing.....	5-52
Selecting the crankshaft main bearing.....	5-54
Selecting the forward gear shims....	6-26, 6-52
Selecting the pinion shims .....	6-25, 6-51
Selecting the propeller shaft shims .....	6-54
Selecting the reverse gear shims....	6-27, 6-52
Selection .....	1-27
Self-diagnosis .....	9-19
Self-protection.....	1-3
Serial number.....	1-4
Shimming .....	6-25, 6-51
Shimming (counter rotation model) .....	6-50
Shimming (regular rotation model).....	6-24
Special service	
tools .....	3-1, 4-1, 5-1, 6-1, 7-1, 8-1, 9-1
Specified torques .....	2-14
Starboard and rear views.....	8-3
Starter motor .....	8-21
Starting system .....	8-19
Symbols .....	1-2
Synchronizing the throttle valve .....	4-16

## T.

Technical tips .....	1-18
Test run .....	1-31
Throttle control .....	4-13
Tightening torques .....	2-14
Top cowling.....	3-4
Top view.....	8-6

## U.

Upper case, steering arm, swivel bracket and clamp brackets .....	7-7
--	-----

## V.

Valve train system.....	1-9
Vapor separator .....	4-5
Ventilation .....	1-3

## W.

Wiring harness .....	8-7
----------------------	-----

## Y.

Yamaha Diagnostic System.....	9-2
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## Wiring diagram

### F200TR, LF200TR, F225TR, LF225TR

- ① Low-pressure fuel pump
- ② Accessory battery
- ③ Fuel pump driver and isolator
- ④ High-pressure fuel pump
- ⑤ Idle speed control
- ⑥ Fuel injector
- ⑦ Spark plug
- ⑧ Ignition coil
- ⑨ Intake air pressure sensor
- ⑩ Thermoswitch
- ⑪ Engine temperature sensor
- ⑫ Pulser coil
- ⑬ Stator coil
- ⑭ Rectifier Regulator
- ⑮ Throttle position sensor
- ⑯ Shift cut switch
- ⑰ Neutral switch
- ⑱ ECM
- ⑲ Fuse (5 A)
- ⑳ Fuse (30 A)
- ㉑ Fuse (20 A)
- ㉒ Starter relay
- ㉓ Starter motor
- ㉔ Power trim and tilt relay
- ㉕ Power trim and tilt motor
- ㉖ Trim sensor
- ㉗ Starting battery
- ㉘ Intake air temperature sensor
- ㉙ Main relay
- ㉚ Oil pressure sensor
- ㉛ Power trim and tilt switch

- [A] To warning indicator
- [B] To remote control
- [C] To trim meter
- [D] To computer
- [E] To diagnostic indicator

(\*1) Isolator cable (optional)

(\*2) Negative cable (commercially available)

#### Color code

B	: Black
Br	: Brown
G	: Green
L	: Blue
Lg	: Light green
O	: Orange
P	: Pink
R	: Red
Sb	: Sky blue
W	: White
Y	: Yellow
B/O	: Black/orange
B/W	: Black/white
B/Y	: Black/yellow
Br/W	: Brown/white
G/B	: Green/black
G/R	: Green/red
G/W	: Green/white
G/Y	: Green/yellow
L/R	: Blue/red
L/W	: Blue/white
L/Y	: Blue/yellow
O/B	: Orange/black
O/R	: Orange/red
O/Y	: Orange/yellow
P/B	: Pink/black
P/G	: Pink/green
P/W	: Pink/white
R/B	: Red/black
R/Y	: Red/yellow
W/B	: White/black
W/G	: White/green
W/R	: White/red
Y/G	: Yellow/green



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